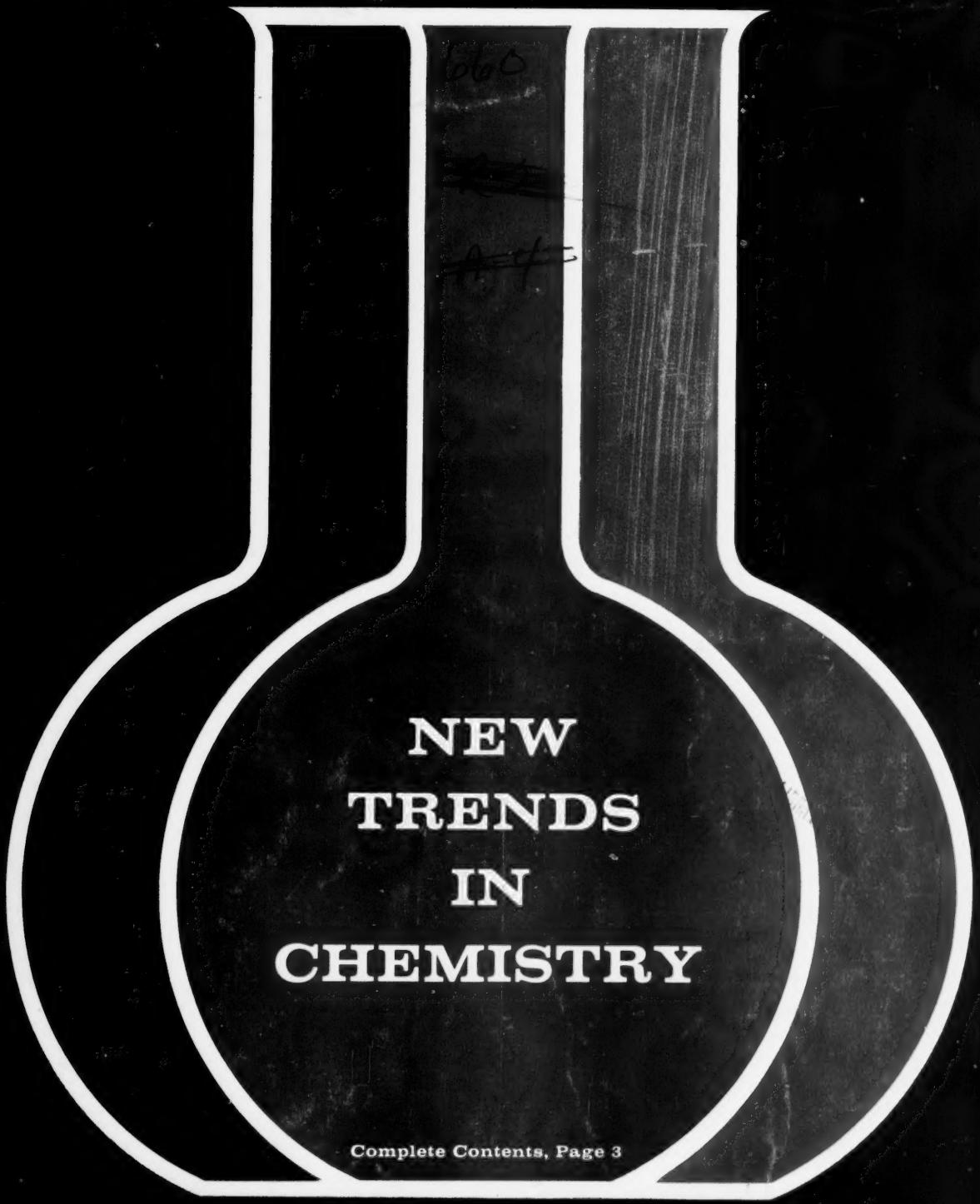
CHEMICAL ENGINEERING

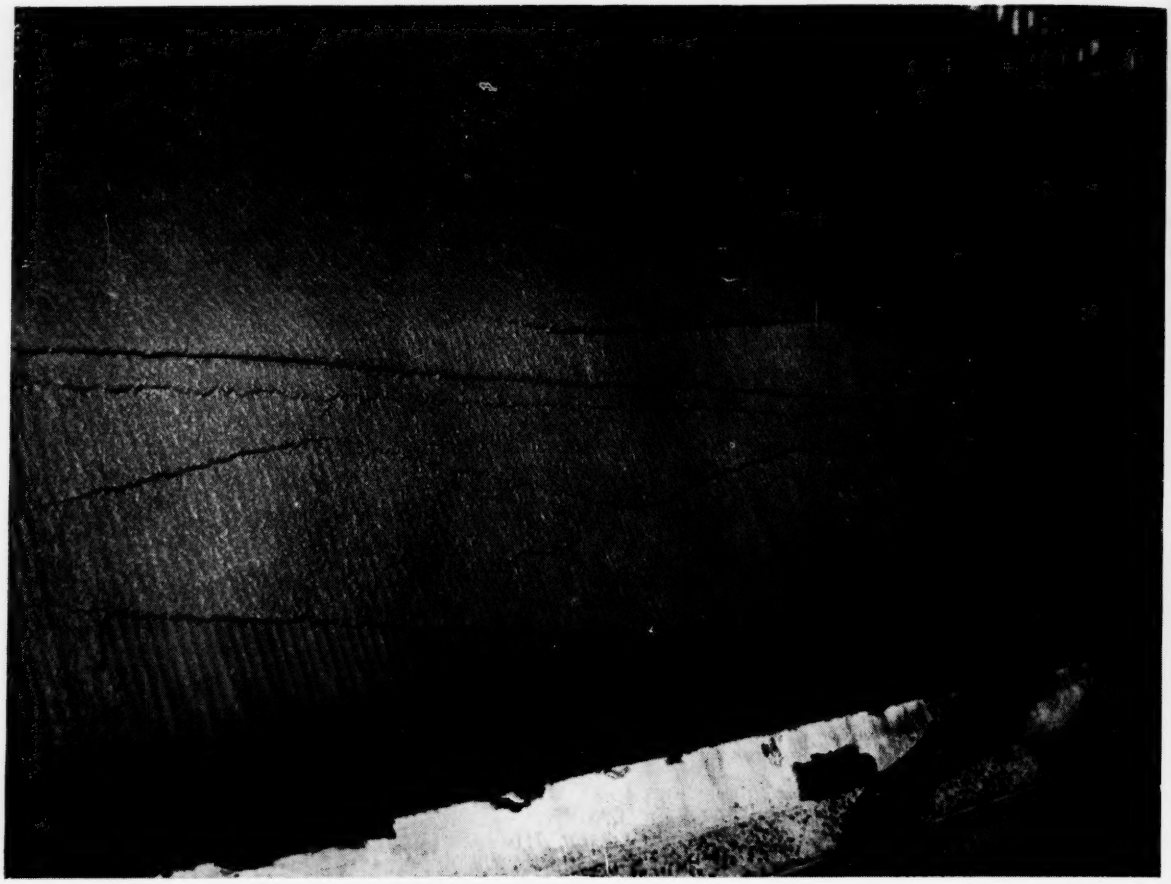
OCTOBER 16, 1961

Graw-Hill Publication Published every-other-Monday / Seventy-five cents



NEW TRENDS IN CHEMISTRY

Complete Contents, Page 3



ONLY the EIMCOBELT is successfully aligning wide cloth belts

In developing the EimcoBelt continuous belt filter, it became apparent that an effective belt alignment mechanism had to be able to maintain a cloth belt filter medium in continuous alignment even across the full span of a 12-ft, 14-ft, or 16-ft face filter.

An alignment mechanism must overcome forces that cause wrinkling . . . it must compensate for cloth's inherent lack of dimensional stability . . . and correct for belt "mooning" and "biasing."

To accomplish this, Eimco research engineers developed an entirely new principle of alignment for cloth, a mechanism that has proved to be as effective on wide belts as on 3 to 6-ft face units. This mechanism, available only on EimcoBelt filters, has been successful in over 200 cloth belt installations, of which a third are 14 and 16-ft units.

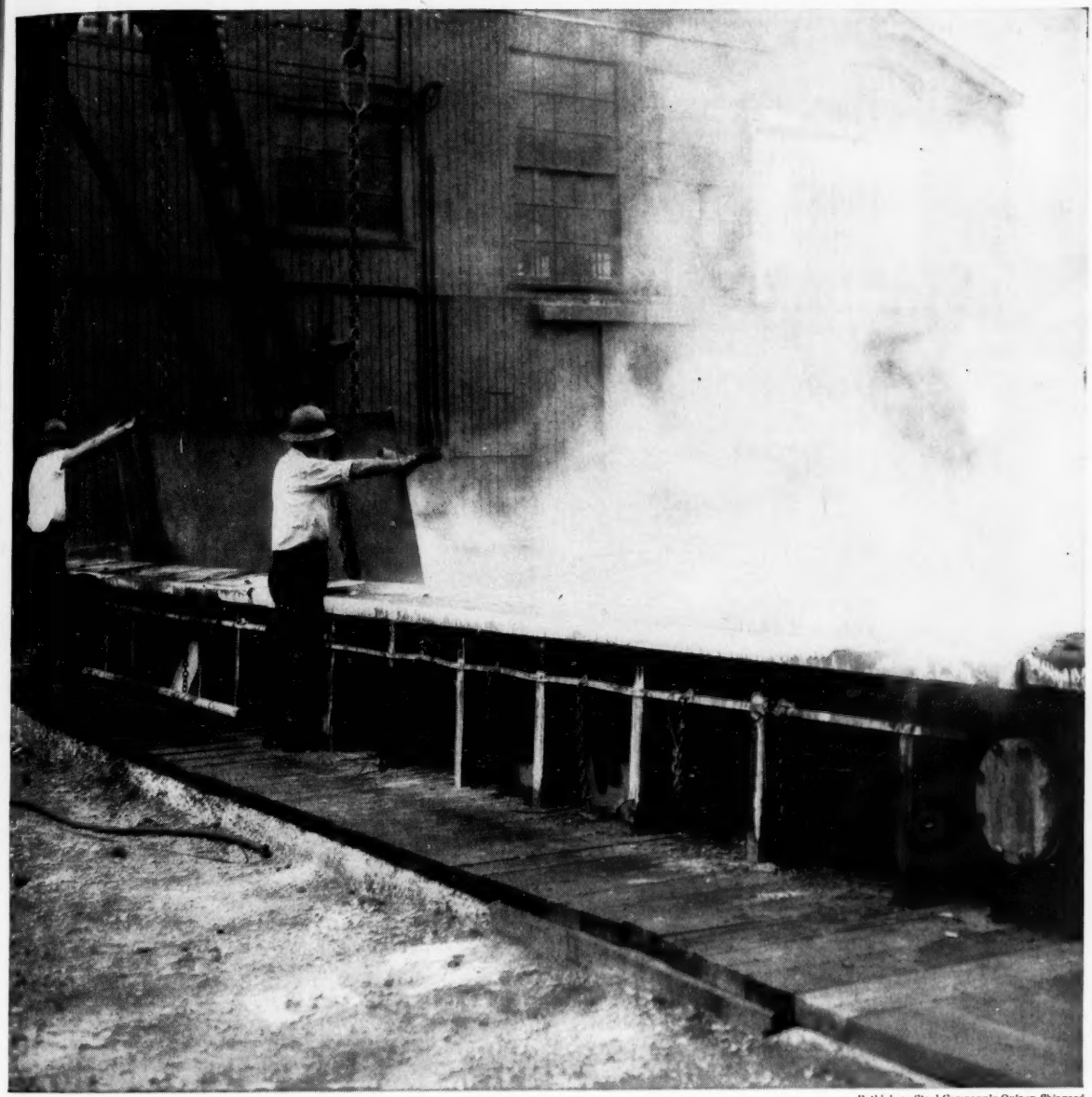
No uneven stretching of cloth medium at belt edges with EimcoBelt aligning mechanism. Write Eimco Filter Division, Salt Lake City 10, Utah, U.S.A. for Bulletin FE-2053.

EimcoBelt is a registered trademark of the Eimco Corporation.

B-804

EIMCO

"Advanced Engineering and Quality Craftsmanship Since 1884"



Bethlehem Steel Company's Quincy Shipyard

Hot acid meets its match

THAT'S armor plate, soon to be part of a new ship, being plunged into a 26-year-old tank of hot acid. This job of pickling steel used to be dangerous and costly because the only tanks that could hold the acid without corrosion were masonry or wood. And they leaked.

A leakproof tank seemed impossible until B.F.Goodrich engineers came up with a protective lining for metal tanks. The B.F.Goodrich Triflex lining is a combination of hard rubber sandwiched between soft rubber that stands the most corrosive acids. The lining is permanently bonded to the steel tank. And for this job, it was protected from excessive heat and accidental gouges by a sheathing of brick.

The 42-foot tank shown above was lined by this method in 1935. Since then it's been in almost constant use, except for some downtime in 1947.

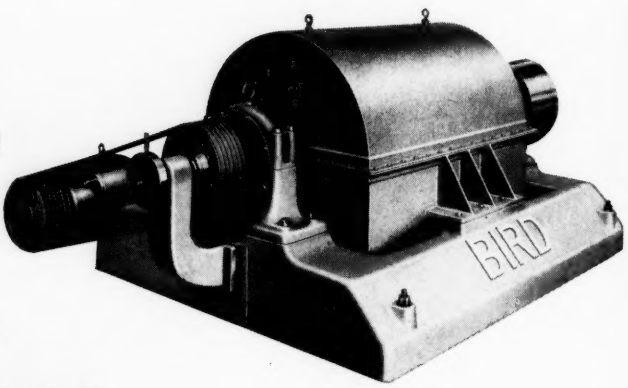
Good as this service life is, we don't claim it's a record-breaker. Some tanks lined by B.F.Goodrich 37 years ago are still in use today. Many have lasted 20 to 30 years. Not one has ever failed to put an end to costly leaks, high maintenance costs, danger to workmen. If you'd like more information about BFG's abilities and facilities for rubber lining, write *B.F.Goodrich Industrial Products Co., Dept. M-172, Akron 18, Ohio.*

B.F.Goodrich

TANK LININGS

Over the past ten years

STANDARD OIL COMPANY OF CALIFORNIA has placed in service twenty-one BIRD Continuous CENTRIFUGALS



At San Francisco, at El Segundo, at Richmond, you will find BIRDS on the job.

For efficient, dependable, low-cost separation of solids from liquids, you can rely on the recommendations of Bird engineers. Their findings, backed by the unsurpassed pilot-scale test facilities of the Bird Research and Development Center, will be unbiased because Bird builds a comprehensive range of equipment for this purpose — continuous solid bowl and screen centrifugals, Bird-Young drum type vacuum filters, Bird-Prayon tilting pan horizontal vacuum filters, pressure leaf filters, batch centrifuges.

Our nearest application engineering office is at your service.

BIRD MACHINE COMPANY
SOUTH WALPOLE, MASSACHUSETTS

BUILDERS OF THE COMPLETE LINE OF SOLID-LIQUID SEPARATING EQUIPMENT
Operators of the **Bird Research and Development Center** for pilot-scale testing to determine the correct equipment for the job. Yours to use.

Application Engineering Offices:
EVANSTON, ILL. • ATLANTA, GA. • HUNTINGTON, W. VA. • WALNUT CREEK, CALIF.

CHEMICAL ENGINEERING

October 16, 1961

CHEMICAL TECHNOLOGY FOR PROFIT-MINDED ENGINEERS

COVER: Typifying "New Trends in Chemistry," the subject of the CE-ARF co-sponsored conference on this subject that has just been held in Chicago, the flasks introduce the series of Conference articles to be published in this year's remaining issues.

OTHER REGULAR FEATURES

5 HIGHLIGHTS
7 LETTERS: PRO & CON
246 CONVENTION CALENDAR
265 TECHNICAL BOOKSHELF
269 READER SERVICE POSTCARD
271 REPRINTS NOW AVAILABLE
272 MANUFACTURERS' LITERATURE
301 CLASSIFIED ADVERTISERS
310 INDEX OF ADVERTISERS
315 ADVERTISING REPRESENTATIVES

PRINT ORDER FOR THIS ISSUE 53,352

VOLUME 68, NUMBER 21

Chemical Engineering (with Chemical & Metallurgical Engineering) is published biweekly by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder.

Executive, Editorial, Circulation and Advertising Offices, 330 West 42nd St., New York 36, N. Y. **Officers of the Publications Division:** Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator; Daniel F. Crowley, Vice President and Controller. **Officers of the Corporation:** Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

Subscriptions are solicited from engineers and other technical men in the Chemical Process Industries. Publisher reserves the right to refuse non-qualified subscriptions. **Position, company connection, and nature of company's business, products, and approximate number of employees, must be indicated on subscription application.** Subscription rates per year for individuals in the field of the publication: U. S. and Possessions $3 (single copies 75¢). Canada $4, other Western Hemisphere $15, all others $25. **Unconditional guarantee:** The publisher, upon written request from any subscriber, agrees to refund the part of the subscription price applying to copies not yet mailed.

Printed in Albany, N. Y.; second class postage paid at Albany, N. Y. and at additional mailing offices. Title ®registered in U.S. Patent Office. ©Copyrighted 1961 by McGraw-Hill Publishing Co., Inc. All rights reserved.

Subscriptions: Send correspondence and change of address to Fulfillment Manager, Chemical Engineering, 330 West 42nd Street, New York 36, N. Y. Send notice promptly for change of address, giving old as well as new address. Enclose an address label from a recent issue of the magazine if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Chemical Engineering, 330 W. 42nd St., New York 36, N. Y.

Audit Bureau of Circulation

Associated Business Publications

85 CHEMENTATOR

91 INDUSTRY & ECONOMIC NEWS

Plants Ride Out Hurricane As Planning Averts Disaster *94*

Producers Step Up Capacity To Meet Potash Push *98*

Process Wrings Pure Nitrogen From Nitric Fumes *102*

Solar Energy Sparks A New Hope For Underdeveloped Areas *104*

New Units Bleach Denser Pulp *106*

CPI News Briefs *108*

110 NEW CHEMICALS

116 NEW EQUIPMENT

Equipment Cost Index *260*

160 PROCESS FLOWSHEET

"Oil" Refinery, New Style, Geared To Hydrocarbons Trend

167 FEATURE ARTICLES

What's New In Chemistry? *167*

High-Temperature and Plasma Chemistry *168*
J. L. Margrave

High-Pressure Chemistry *177*
R. H. Wentorf, Jr.

187 C.E. REFRESHER

Estimate Transport Coefficients *187*
L. D. Smoot

191 FEATURE REPORT

Semiannual Inventory of New Plants and Facilities

201 YOU AND YOUR JOB

Will Your Next Move Be Easy To Make? *204*

Market Price of Chemical Engineers: Going Down? *208*

210 OPERATION & MAINTENANCE

Centrifugal Pump Lubrication* *210*
J. H. Doolin

Coexistence for Design and Operating Engineers? *216*
W. H. Richardson

222 CORROSION FORUM

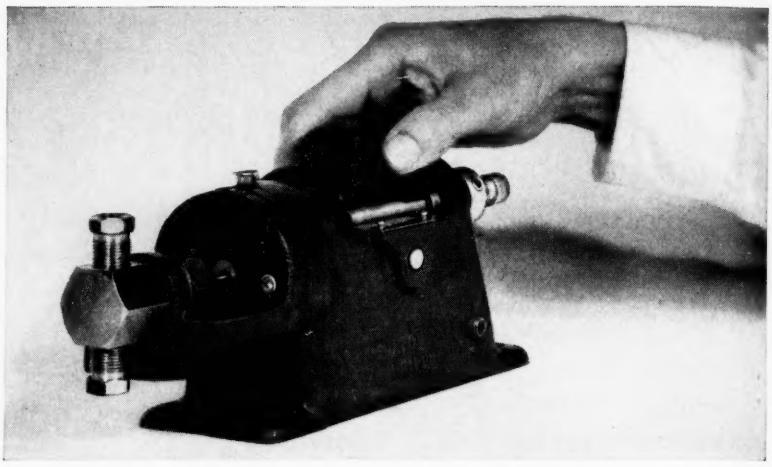
Spray Plastic and Reinforcement Simultaneously *222*

Magnesium In Zinc Improves Corrosion Resistance *226*

*FREE—For an extra copy of this article, Check Reader Service Card, p. 269

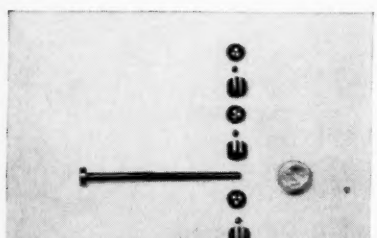
how to meter small quantities of liquid accurately

THERE'S no basic change in the physical properties of a liquid whether you pump large or small volumes. But as the volume being pumped approaches the milliliters per hour (ml/hr) range, several constant characteristics of liquids tend to become serious problems. Metering success depends on how well these problems are solved by pump design and operating practice.



Compressibility:

All liquids are compressible, but so slightly that there is rarely much cause for concern. In small volume metering, however, the 0.027% reduction in volume of water which accompanies each additional 100 psi pressure can represent a 0.3% loss in pumping efficiency. Thus the existence of high or fluctuating discharge pressures *must* be considered when choosing a micro pump.



Entrapped air:

Bubbles can be troublesome even in high capacity controlled volume pumps. But when you're metering at the rate of 1/60 *ml per stroke* to 0.3% accuracy, a bubble can spell disaster. Good pump design can minimize the bubble problem by speeding bubbles through the liquid end in a very few strokes, but only good pumping practice can eliminate it. In our experience, there is no substitute for a deaerator in the line.

Viscosity:

Low viscosity liquids tend to pass between any but the most perfectly mated ball checks and seats. Ball seating techniques recently introduced by Milton Roy have eliminated this problem, however, and extended the number of liquids that can be accurately pumped in small volumes. For example, a miniPump® is now successfully pumping 85 ml/hr of cyclohexane against a discharge pressure of 1,000 psi to an accuracy of ±0.6%.

Minute volumes also impose tight specifications on the pump itself. Plungers, balls, and seats must be finished to a degree of near perfection. Parts are inspected under powerful microscopes for any sign of imperfections. Proper mating of balls and seats is so critical that a rigorous functional test is necessary.

Solving these unusual problems demands such special equipment as the Milton Roy miniPump, *and* special pumping practices. Together they permit numerous metering jobs not otherwise possible. MiniPumps are standard equipment wherever small volumes of expensive or dangerous liquids are to be accurately metered into large process streams: perfumes into soap, dyes into cheese, odorants into natural gas, and hydrazine and other amines into boiler water. MiniPumps have also proved themselves in the chromatographic analysis of amino acids, feeding influent buffers to the columns and accurately introducing ninhydrin reagent to the effluent.

If precision pumping of small volumes of liquid is one of your problems, look to Milton Roy's 25 years of experience for your most economical solution. For more detailed information on miniPumps, write for Bulletin 1257-1. Milton Roy Company, 1300 East Mermaid Lane, Phila. 18, Pennsylvania.

milton Roy
CHEMICAL INSTRUMENTATION SYSTEMS

Controlled Volume Pumps
Colorimetric Analyzers
Hydrogen Purifiers
Laboratory Instruments

1936-1961
25 YEARS

CHEMICAL ENGINEERING

PUBLISHER
J. Elton Tuohig

EDITOR-IN-CHIEF
Cecil H. Chilton

WHAT'S HAPPENING
EDITOR: Calvin S. Cronan
ASSOCIATE EDITORS: Frances Arne, A. V. Gemmill
ASSISTANT EDITORS: Charles R. Bamford, Nicholas P. Chopey, Eugene Guccione, Roland A. Labine, Frederick C. Price

ENGINEERING PRACTICE
EDITOR: Theodore R. Olive
SENIOR ASSOCIATE EDITOR: Robert B. Norden
ASSOCIATE EDITORS: Steven Danatos, W. C. Schall
ASSISTANT EDITORS: Roy V. Hughson, James R. Marshall, Herbert Popper

PRESENTATION & PRODUCTION
EDITOR: Lester B. Pope
SENIOR ART EDITOR: Frank F. Kozelek, Jr.
ASSOCIATE ART EDITOR: Louis H. Dufault
ASSISTANT ART EDITOR: D. Caratzas
COPY EDITOR: Henry S. Gordon
EDITORIAL ASSISTANTS: Joan Nilsen, Nancy Pepicello

REGIONAL EDITORS & BUREAUS
HOUSTON: Peter J. Brennan, Wilma Cortines
SAN FRANCISCO: Martin D. Robbins, Terry Shaw
DOMESTIC NEWS BUREAUS: Atlanta, Chicago, Cleveland, Dallas, Detroit, Los Angeles, San Francisco, Seattle, Washington
WORLD NEWS BUREAUS: Bonn, London, Mexico City, Milan, Moscow, Paris, Rio de Janeiro, Tokyo. Correspondents in 170 cities in 69 countries.

CIRCULATION
MANAGER: Paul W. Erb

ADVERTISING & BUSINESS
ADVERTISING SALES MANAGER: D. B. Gridley
BUSINESS MANAGER: Anton J. Mangold
PROMOTION MANAGER: Hugh T. Sharp
MARKET RESEARCH MANAGER: Jeanette Paschall
ADVERTISING MAKEUP: Grace Barrie

highlights of this issue

NEW TRENDS IN CHEMISTRY

In this issue (p. 167) are the first two of 14 papers presented last week in Chicago at a conference sponsored jointly by Armour Research Foundation and CHEMICAL ENGINEERING. Leading off are John Margrave (University of Wisconsin) on plasma and high-temperature chemistry, and Robert Wentorf (General Electric) on high-pressure chemistry. Others will follow in subsequent issues.

CPI RIDES THROUGH HURRICANE CARLA

How did chemical plants and petroleum refineries fare when Carla struck the Gulf Coast last month? Here's an on-the-spot report from McGraw-Hill reporter Glenn Green (p. 94). With few exceptions, he found that physical damage was relatively light. Advance planning and ample warning had paid off handsomely.

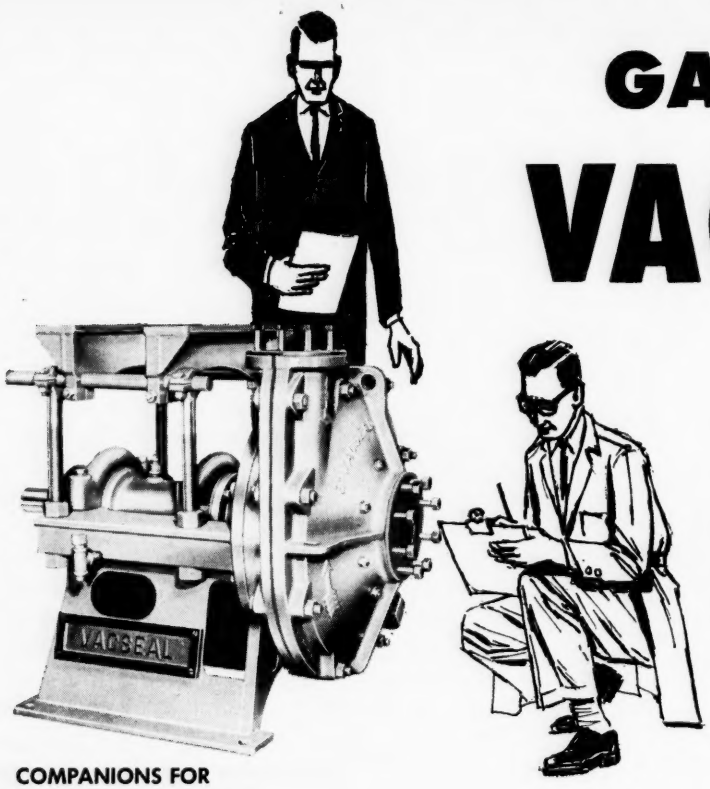
SPRAYS BOTH PLASTIC AND REINFORCEMENT

Reinforced plastic coatings can now be applied to chemical process equipment much more easily, according to Corrosion Forum (p. 222). Technique involves simultaneous spraying of both the plastic and chopped glass fiber reinforcement, using a special new spray gun. Method is said to be less costly than conventional layup methods.

THIS "OIL" REFINERY HAS NO CRUDE SUPPLY

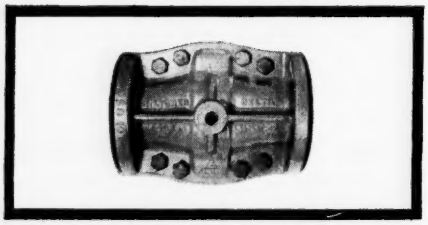
An oil refinery without a supply of crude is unusual, to say the least. This 5,000-bbl./day refinery of Canadian Oil Cos., Ltd., is operating completely on a feedstock of natural gas liquids, producing heating, diesel fuel and butane, in addition to premium and regular gasolines. Our Process Flowsheet (p. 160) shows how it's done.

GALIGHER VACSEAL

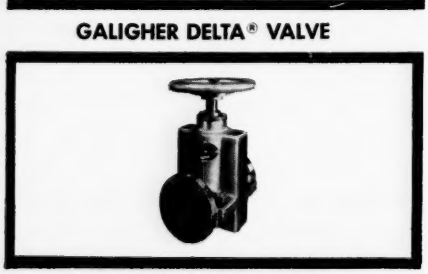


CUSTOM ENGINEERED FOR YOUR PUMPING REQUIREMENTS

COMPANIONS FOR MATERIAL FLOW CONTROL



GALIGHER DELTA® VALVE



GALIGHER SQUEEZE VALVE

Both feature straight-through flow replaceable diaphragms. Valve bodies available in cast iron, aluminum and ductile iron.

- **Exclusive impeller design eliminates gland leakage.**
- **Sealing water is not required.**
- **Designed to handle abrasive slurries, corrosive solutions, high-density pulps, semi-solids, sludges or slimes.**
- **Available in sizes from 1½" to 8" to handle capacities up to 3,600 GPM, with heads up to 100 ft. and particle sizes up to ⅜".**
- **Impellers and replaceable, non-collapsible liners furnished in Natural Rubber, Neoprene, Hypalon, Buna or Butyl reduce replacement costs.**
- **Pumping elements also available in Cast Iron, Stainless Steel, and other alloys.**
- **Gland parts are available in Teflon, Ceramic, Haveg, Bronze, Stainless Steel, Cast Iron, Hastelloy, or other alloys.**
- **Direct or V-belt driven models available.**

PLACE A GALIGHER VACSEAL ON TRIAL IN YOUR PLANT.

GALIGHER

CONSULTATION • ORE TESTING • PLANT DESIGN

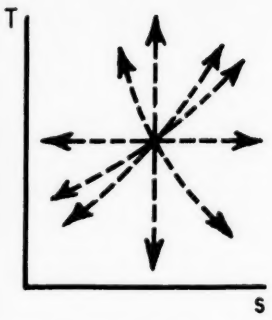
GALIGHER PRODUCTS: AGITAIR Flotation® Machine, VACSEAL Pump, Geary-Jennings Sampler, Acid-proof Sump Pump, Galigher DELTA® Valves, Galigher Squeeze Valves, Rubber Lined and Covered Products, Plastic Fabrication.

Leaders in Experience and Service

Metallurgical Division . . . Engineering Service

The GALIGHER Co. V.P.-524

HOME OFFICE:
545-585 W. 8th South, P. O. Box 209, Salt Lake City 10, Utah
EASTERN OFFICE:
921 Bergen Ave (Room 922) Jersey City 6, New Jersey



Thermo Texts Defended

Sir:

After reading the recent article by Dr. Cannon (Aug. 7, pp. 127-8) I feel compelled to come to the defense of the thermodynamics textbooks.

In Dr. Cannon's first example—the system with the space above a *weighted* piston evacuated—the statement that "no work is done by a perfect gas expanding into a vacuum" applies only to a system that is confined by a hypothetical *weightless* and frictionless piston. In the case mentioned, the gas is obviously opposed by the weight of the piston, and work must be done to move this piston in any expansion.

In the example of the three containers with pistons of different weights, it would be necessary to specify the force exerted by each piston on the latch, or the number of moles of gas confined by each piston, before any work (or work per foot) could be calculated. In the case described, all the pistons would continue in motion because of lack of friction. If, however, some way were found to stop the pistons at the equilibrium position with the latch removed, the calculation of the work done would not contradict the concept of the work done as being equal to the work received.

J. V. BIGGERS
Union Carbide Metals Co.
Niagara Falls, N. Y.

Arc vs. Open-Hearth Furnace

Sir:

A brief item in your Aug. 7 issue (p. 162) needs to be corrected.

Consolidated Vacuum does not have a steel mill in Philadelphia. The vacuum arc furnace was installed for Midvale Heppenstall.

The story, referring initially to this vacuum arc furnace, continues, "The open-hearth unit produces 40-ton, 60-in.-dia. ingots." The latter statement could not possibly concern a vacuum arc furnace; at best, it is a simple non sequitur.

GEORGE OPREAN
Consolidated Vacuum Corp.
Rochester, N. Y.

Compound Interest Warning

Sir:

The CEQ problem by Dr. Lemlich in the Aug. 7 issue (pp. 148, 152) is, in my opinion, incomplete.

In his solution, the values compared are $(1 + i/2)^2$ vs. e^i for one year, from which he concludes that the difference is not appreciable. However, I believe the comparison should be between values of $(1 + i/2)^{2n}$ vs. e^{in}, since the total difference in future worth by the two procedures could be appreciable, depending upon the value of n.

This comment is to warn the unitiitiated rather than to criticize the problem.

H. E. SCHWEYER
University of Florida
Gainesville, Fla.

Pro: Water Conservation

Sir:

Your *Chementator* story on the salvaging of waste water (Aug. 21, p. 60) focuses well-deserved attention on an important aspect of water quality conservation. The Public Health Service has recognized that increased reuse of waste water is an inevitable consequence of our growing population and industrial complex, and that economical means for effective waste cleansing must be developed.

Our research contract with Ionics Inc., which you described, is only one of a number of projects in waste treatment research initiated by our research branch at the Robert A. Taft Sanitary Engineering Center, Cincinnati. Contracts are now in effect with Dow Chemical Co., Harvard University, Polytechnic Institute of Brooklyn, Radiation Applications, Inc., Applied Science Laboratories and other organizations, for study of the application of physical-chemical principles of separation to the complete treatment of waste waters. Additional contracts are being negotiated. Parallel research is being conducted in our own laboratories.

Our ultimate objectives are two-fold: to concentrate aqueous wastes into volumes small enough for ultimate disposal, and to produce water suitable for indefinite reuse. We are searching for economical processes for removal of all refractory contaminants from water—materials ranging from common inorganic impurities through detergents to extremely complex organic chemicals.

We are convinced that such research is timely and important. It appears to us that major contributions must be made by chemical engineers. This whole area of research is a significant challenge to the chemical engineering profession.

GORDON E. MCCALLUM
Public Health Service
Washington, D. C.

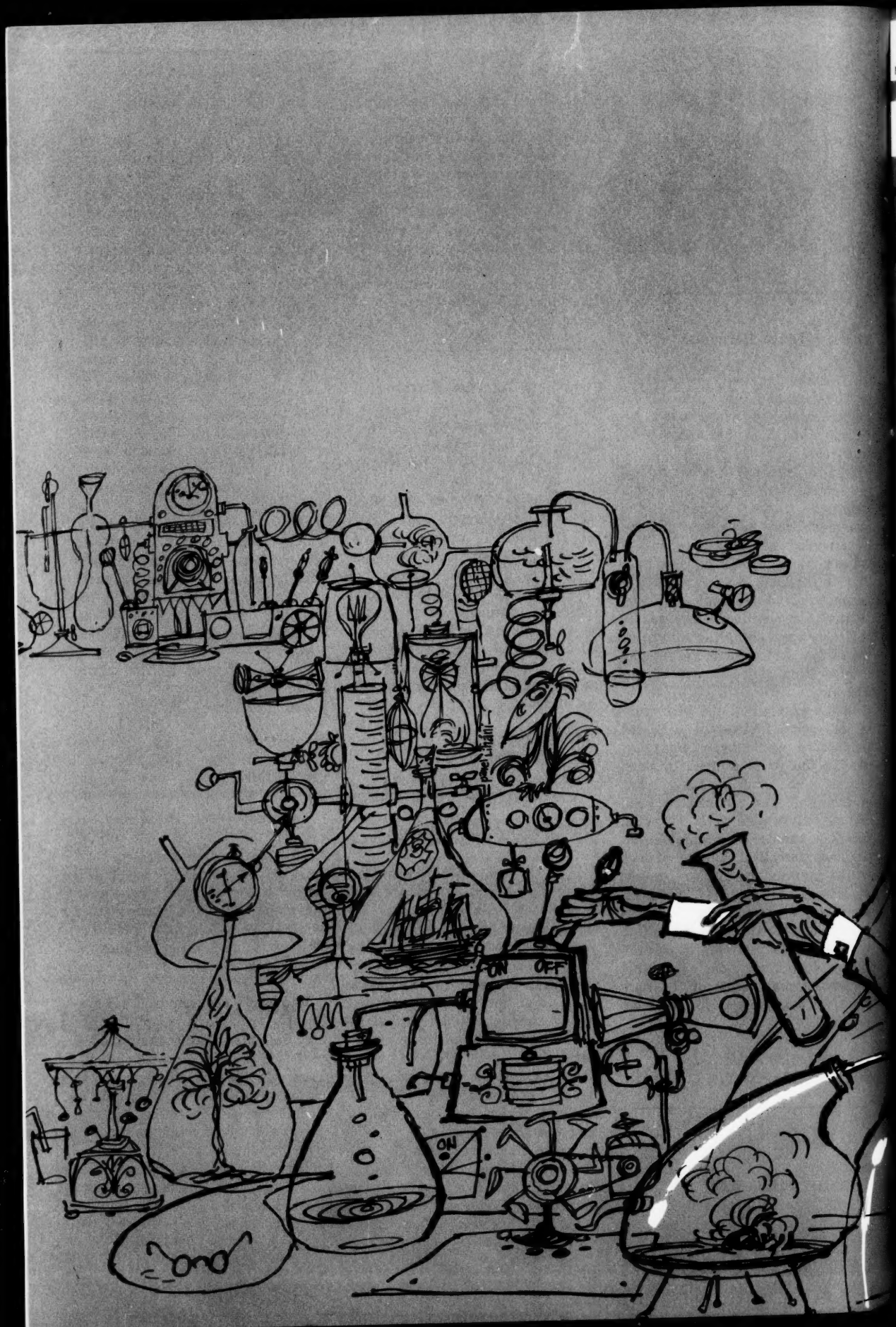
Pro: NIMS

Sir:

The Post Office Department is engaged in the development of NIMS (nationwide improved mail service), the success of which will depend to a very large extent upon the cooperation and good will of business, commerce and industry. This is a new plan designed to schedule the nation's vast mail volume more effectively.

The NIMS program calls for systematic, voluntary scheduling of mail deposits in order to reduce the peak load in post offices between the hours of 5:00 and 10:00 p.m. The efficiency gained by evening out the load on postal facilities will not only speed priority mail an extra 24 hours but will result in economy of operation.

ROBERT K. CHRISTENBERRY
Postmaster
New York, N. Y.


ON
OFF
ON

Even If You Don't Have a Processing Problem...

Can you get Caustic Soda in Elliott Lake, Ontario for $22* a ton?... *Soda Ash in Blue Water, New Mexico, for $28* ...Lime in Hilo, Hawaii, for $55

Of course not, for the caustic soda and soda ash! Certainly yes, in the case of lime. Yet you may be able to substitute Basic's magnesium oxide, MAGOX,® at comparable prices—whatever your location. Surprised? Then perhaps now may be the time to take another and perhaps closer look at your reagent costs — whether or not you have a problem that can be solved by the unique properties of MAGOX. Even in the case of lime, when sludge formation and scaling increase processing costs, MAGOX may actually cost less. Here are just a few examples of how MAGOX helped to solve unusual processing problems by adsorption and controlled neutralization, how MAGOX reduced operating costs:

In Elliott Lake, Ontario

PROBLEM: To avoid gypsum precipitation, yet reduce the high neutralization cost resulting from the use of caustic soda. **SOLUTION:** Use of Basic's MAGOX as a reagent. **RESULT:** A 65% reduction in neutralizing reagent cost, saving more than $5,000 per month.

In Blue Water, New Mexico

PROBLEM: ***Excessive slime build-up due to pH adjustment resulted in plant shut-downs.*** **SOLUTION:** ***Substitution of Basic's MAGOX for the soda ash initially used to solve problem.*** **RESULT:** ***Neutralizing rate satisfactory . . . sliming eliminated . . . a 35% cut in reagent costs over soda ash for an annual saving of more than $60,000.***

In Hilo, Hawaii

PROBLEM: Elimination of gypsum-rich scale on evaporator tubes caused by the "liming" of sugar juices. ***SOLUTION:*** Substitution of Basic's MAGOX for 40% of the lime. ***RESULT:*** Reduction of manual de-scaling costs by more than 80%.. a 20% over-all saving in neutralization process costs, despite higher reagent costs... elimination of premature and unscheduled shut-downs due to scaling.

In Niagara Falls, New York

PROBLEM: Reduction of trace impurities in the manufacture of a heavy chemical. ***SOLUTION:*** Use Basic's MAGOX to adsorb trace impurities in the heavy chemical. ***RESULT:*** Iron impurities were reduced from 15 to less than 5 ppm . . . substantially upgrading the chemical.

HOW CAN *MAGOX* HELP YOU? Produced from beneficiated magnesite ores, Basic's MAGOX is unusually low in cost and high in "problem-solving" capability. With competent laboratory back-up, Basic's chemical specialists are anxious to help analyze *your* particular processing problem. Whether it involves neutralization, adsorption, precipitation or other operations, MAGOX may now be your least expensive solution. Let us know if you would like more complete information on the unique properties of MAGOX and on its many successful applications.

*Recent net ton FOB works price listings are: 50% caustic soda, $50.00; 58% soda ash, Lt., bgd. $37.50; chemical hydrated lime, bgd. $17.25.

CHEMICAL DIVISION

BASIC INCORPORATED
845 HANNA BUILDING • CLEVELAND 15, OHIO

One insulation for many service temperatures

Th

This is **Careytemp**®

Composition
A new pipe and block insulation material . . . millions of glassed-in air cells of expanded silica bound together, reinforced with inorganic fibres. Gives exceptional strength, yet is lighter than other industrial insulations. Density: 9 lbs. per cu. ft.

High Moisture Resistance
Absorbs practically no moisture. Minimum efficiency loss under wet or humid conditions.

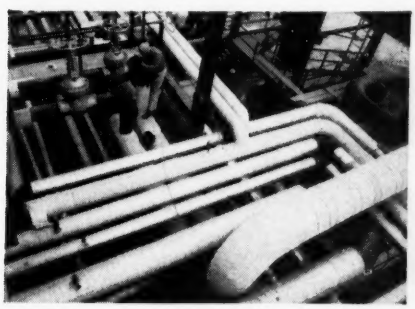
Low Shrinkage
Practically no linear shrinkage, even at high temperatures (0.7% at 1200° F.). Minimum heat loss at joints.

Low Thermal Conductivity
Only .33 B.T.U./sq. ft./hr./°F. at 100° F. — .77 at 1000° F. mean.

High Acid & Corrosion Resistance
Improved performance on acid-processing and stressed stainless steel equipment. Not damaged by most acids. Chemically - inert composition ideal where corrosion is a problem.

Wide Size Range
Available in larger labor-saving sizes. Blocks in new 24" widths and pipe insulation in half sections through 24" pipe size.

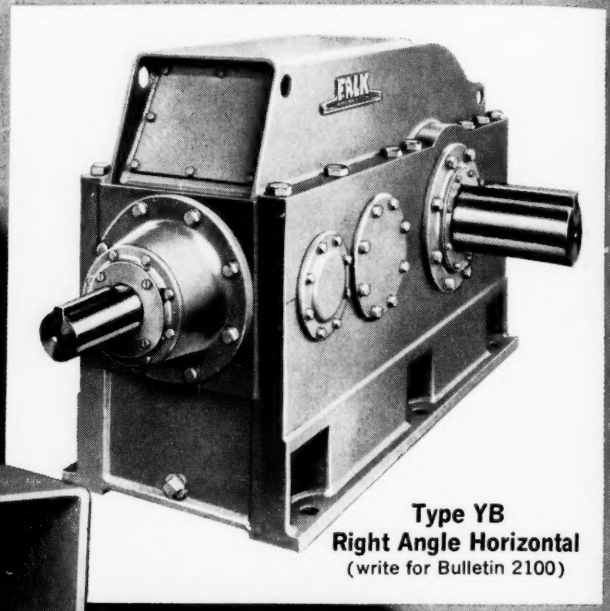
Over four years of field use have proved Careytemp, following thorough laboratory testing at Mellon Institute of Industrial Research. For Careytemp samples and additional specifications, write Dept. CH-1061, Insulation Division, The Philip Carey Mfg. Company, Cincinnati 15, Ohio.



Sohio Chemical Company, Lima, Ohio. Careytemp specified exclusively to cover the wide range of temperatures encountered in this modern chemical processing plant.

FALK INTRODUCES 2 NEW SERIES OF VERSATILE SPEED REDUCERS

Designed to serve industry's current and future requirements



Type YB
Right Angle Horizontal
(write for Bulletin 2100)

Type Y Parallel Shaft
(write for Bulletin 1100)

Parallel Shaft and Right Angle Horizontal Reducers cataloged thru 1,570,000 lb-in. torque at low speed shaft ...larger units upon request. Ratios 1.84 thru 292 to 1 for parallel shaft; 5.06 thru 1207 to 1 for right angle horizontal

These new units are probably the most thoroughly engineered speed reducers on the market today. Final designs based upon years of development study and a background of 50 years experience make these units as dependable as the name "FALK". A few of their many features are...

PINPOINT APPLICATION COVERAGE Wide choice of sizes and ratios permits the most economical selection of a correctly rated unit for each application. In each series of parallel shaft and right angle reducers, cataloged sizes range up to 1,570,000 lb-in. torque at the (11 inch dia.) low speed shaft. (Other standard designs to 25,000,000 lb-in. torque; custom designs for higher capacities.)

UNMATCHED VERSATILITY The "Basic Y" speed reducer design permits economical modification to meet a multitude of specific requirements. Smooth, flat surfaces simplify mounting of motor brackets, backstops, brakes, and any number of other accessories.

RUGGED HOUSINGS Sturdy housings not only provide maximum rigidity to maintain proper alignment of gearing, but also have the strength to support heavy overhung loads and withstand accidental blows.

DEPENDABLE FALK GEARING Gears are selected with the proper proportions and hardness to provide the optimum combination of maximum durability and strength for high shock as well as uniform loads.

BEARINGS TO SUIT THE OVERHUNG LOAD Standard reducers can meet custom-built requirements with optional stock bearings and shafts (at only a nominal extra charge.) Maximum overhung load capacities are so great that for some conditions, still within the capacity of the reducer, extra strong supporting foundations and bolts must be provided.

DOUBLE GEAR LIFE Standard double ended shafts can be reversed end for end to bring into contact the unused surfaces of the gear teeth for twice the normal gear life.

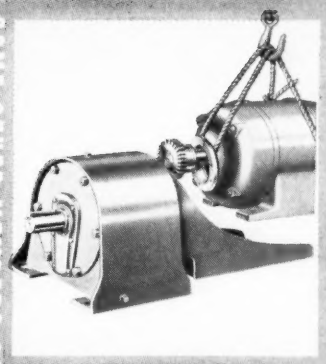
SEALS FOR ALL CONDITIONS Standard equipment oil seals assure oil-tight and dirt-free gear units for normal applications. Standard abrasive and moisture-resistant seals available upon order.

THE FALK CORPORATION, MILWAUKEE 1, WISCONSIN

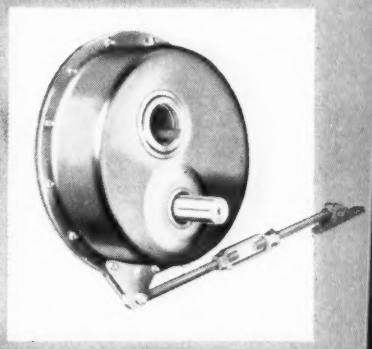
MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS

Representatives and Distributors in most principal cities

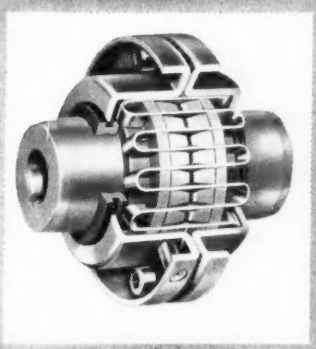
SOME OTHER MEMBERS OF AMERICA'S FIRST FAMILY OF POWER TRANSMISSION PRODUCTS



ALL-MOTOR MOTOREDUCERS



SHAFT MOUNTED DRIVES

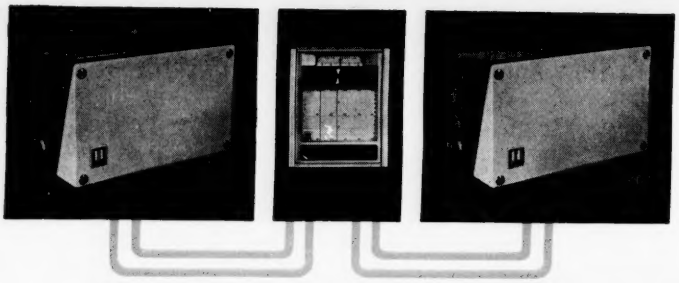


STEELFLEX COUPLINGS

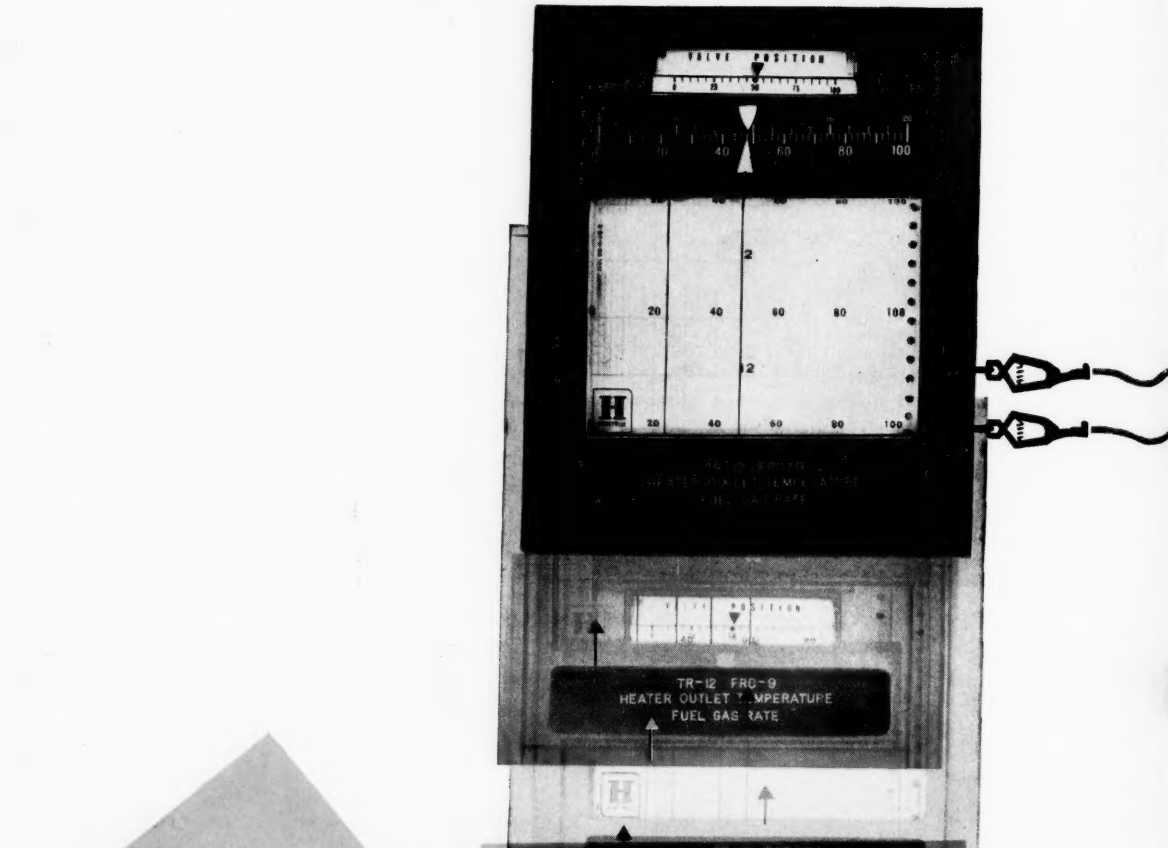
FALK

A GOOD NAME IN INDUSTRY

FALK, ALL-MOTOR, and STEELFLEX are registered trademarks



***ElectriK Tel-O-Set*—the true 2-wire system**



This "Loop Snooper" adds to the extraordinary ease of installation and maintenance you'll find in the *ElectriK Tel-O-Set* System. It's a portable test instrument that can accurately check . . . from the control panel . . . any *Tel-O-Set* unit in the field, to make sure signals are being received and sent exactly as they should be. Or it can operate and check a recorder chassis, indicator chassis or controller on the bench, with local power. The "Loop Snooper" removes trial and error from installation and maintenance.

SIMPLEST TO INSTALL, ADJUST AND MAINTAIN

The *ElectriK Tel-O-Set* System has many features that save time in getting on stream, and keep maintenance to a minimum. For example, all process connections are isolated from the inside of *Tel-O-Set* transmitter and transducer cases, so that you can mount, pipe and wire the instruments without removing their covers. Instrument chassis can be removed for servicing without breaking any external process or electrical connections. Standardized parts and extensive use of quick-connect and plug-in design cut downtime and spare parts requirements.

No external power is required at any field-mounted *Tel-O-Set* instrument; line power is connected only at the receiver. Two-wire d-c transmission eliminates shielding and further reduces installation costs. The 4-20 milliamp signal range gives a *live* zero through the use of readily available reliable transistors.

Your nearby Honeywell field engineer can tell you how *ElectriK Tel-O-Set* advantages relate to your particular control requirements. Call him today . . . he's as near as your phone. Or write to MINNEAPOLIS-HONEYWELL, 21 Penn Street, Fall River, Massachusetts.

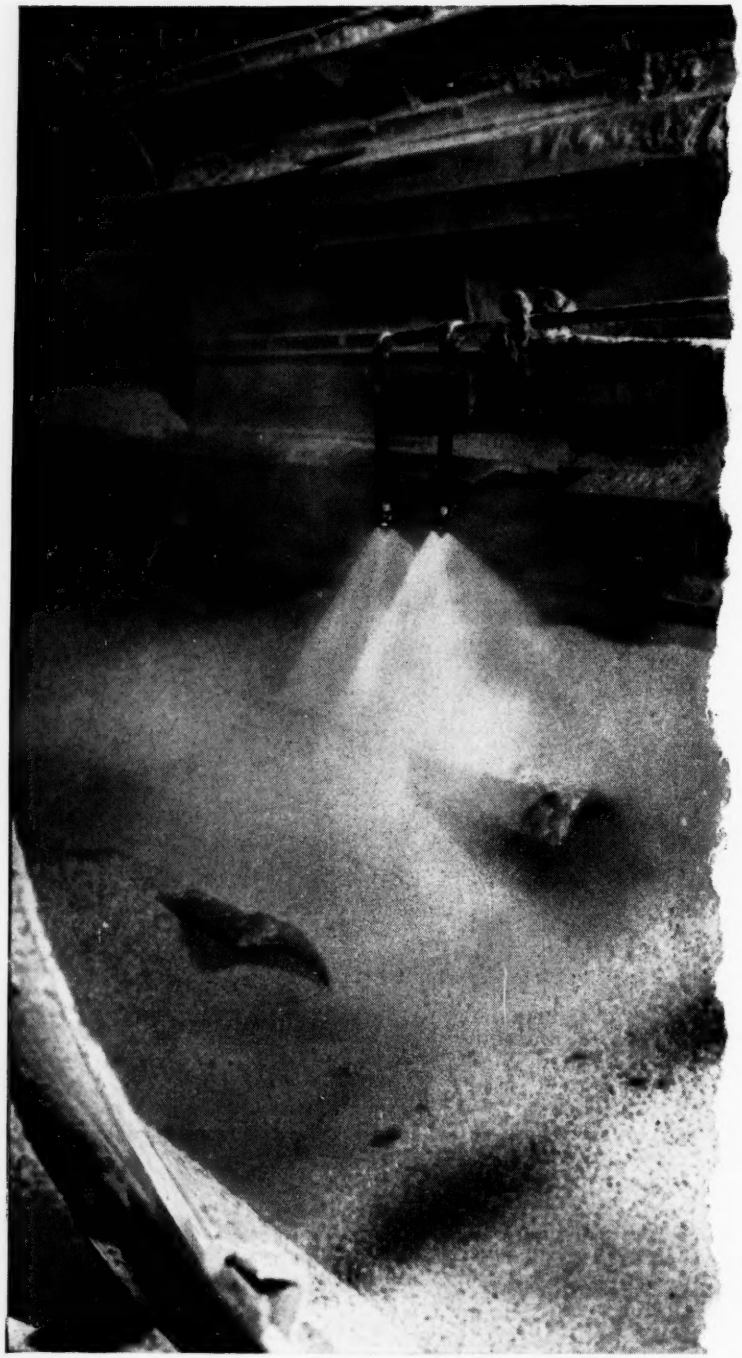
Honeywell

First in Control

SINCE 1885

HONEYWELL INTERNATIONAL Sales and Service offices in all principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.

a bit of ARMOFLO here...



ARMOUR IDEA CHEMICALS

A pound, or less, of Armoflo® compound will condition a ton of various hard-to-handle dry materials. Applied at an appropriate stage in processing, these liquid conditioners assure free flow of the product in process, function as anti-caking and anti-dusting agents during subsequent handling and storage.

Armoflo compounds may be applied as received, by spraying, dripping or fogging onto the product while it is tumbling in rolling or blending equipment. Armoflos coat each particle with a monomolecular layer that changes hygroscopic surfaces to hydrophobic. They will withstand product heats up to 325° F. and are stable in storage for long periods. Armoflo compounds also provide virtually complete corrosion inhibition for iron and steel processing equipment.

A smoother, faster, more even flow of product results when Armoflos reduce friction between particle surfaces. This lubricating action reduces abrasion and thus reduces "fines" and dust formation.

Armoflos are now being used commercially with a number of products and current testing indicates many more potential applications. The versatility of Armoflo compounds is demonstrated by the following three categories of materials.

FERTILIZERS

Armoflo compounds are effective conditioners for all types of mixed fertilizers —low as well as high analysis grades. The compounds act as anti-dusters on low analysis grades and as anti-dusters and/or anti-cakers in high analysis grades. Armoflos are being used effectively as anti-dusting and anti-caking agents on these typical grades:

Anti-caking and Anti-dusting of High Analysis Grades	Anti-dusting of Low Analysis Grades
0-20-20	0-20-0
5-10-5	3-12-12
5-20-20	3-9-18
7-21-21	3-9-27
7-28-14	4-12-8
10-10-10	4-12-12
12-12-12	5-40-0
15-15-15	8-8-8
17-7-0	10-6-4

Armour Industrial Chemical Company

One of the Armour Chemical Industries • 110 North Wacker Drive, Chicago 6, Illinois

DOES A BIG JOB HERE

SINGLE FERTILIZER SALTS

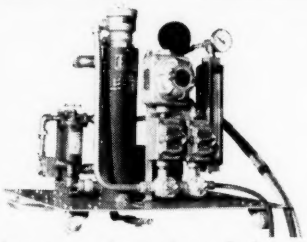
Many of the salts used in formulating mixed fertilizers are hygroscopic and must be conditioned to prevent caking. Armoflo compounds successfully inhibit caking, improve product flow and reduce dust resulting from abrasion. Typical of such Armoflo applications are:

- Ammonium chloride
- Ammonium sulfate
- Diammonium phosphate (21-53-0 and 16-48-0)
- Manure salts
- Monoammonium phosphate
- Nitrate of lime
- Potassium chloride
- Potassium nitrate
- Potassium sulfate
- Sodium nitrate
- Urea (prill & crystal)

OTHER MATERIALS

Armoflo compounds likewise do an effective job of helping prevent caking and dusting of various inorganic and organic materials. They function well across a wide pH range from acidic to highly alkaline. The materials listed below, as well as similar products, can be successfully conditioned.

- Caustic Soda
- Detergents
- Dextrin-urea blends
- Fluorspar
- Glues (mixed, powdered)
- Guar gums
- Hypochlorites
- Insecticides
- Magnesium oxide
- Metallic soaps
- Pentachlorophenol
- Rock salt
- Sodium bisulfate
- Sodium chlorate
- Sodium metasilicate
- Sulfur
- Sylvite
- Thermosetting plastics
- Zinc chloride



Armour engineers have designed and built a portable spray unit which demonstrates the effectiveness of Armoflo compounds in the most practical way—right in your plant. This self-contained unit permits conditioner application at several different points of product processing.

ARMOUR IDEA CHEMICALS

Armour Industrial Chemical Company
110 N. Wacker Drive • Chicago 6, Ill.

Please send me:

☐ a copy of your new, revised edition of "ARMOFLO—Armour Anti-dusting and Anti-caking Chemicals."

☐ a sample for conditioning..... (Name of your product)

Name.....Title.....

Company.....

City.....Zone.....State.....

Don't get boxed in by oxygen supply problems... let

Maintain flexibility in your operations by removing all uncertainties about availability of oxygen for your chemical process requirements. Buy oxygen as a tonnage pipeline chemical commodity — let Airco build and operate a plant for you.

An Airco plant assures you of all the oxygen you require . . . piped to you at a steady rate . . . at a firm, fair price. And if you need nitrogen, that too is available from the air separation plant we build.

GUARANTEED BACK-UP. Your new plant is part of Airco's integrated system of supply. If your oxygen requirements increase . . . or if the oxygen plant is down for any reason, you're not squeezed. Airco will meet your needs from its nationwide network of oxygen plants.

NO CAPITAL INVESTMENT. Airco finances the oxygen plant, whether it's on property leased from you or on our over-the-fence site. You pay only for oxygen . . . have the capital for the oxygen plant available for other

let Airco build and operate a plant for you

chemical process requirements.

PROVEN TECHNOLOGY. Air separation is a specialized business. Airco has 45 years' experience in low-temperature technology . . . design, engineering and construction proficiency that has dotted the country with oxygen plants. There's no first-plant guesswork . . . late starts . . . long shake-down periods that ruin your production schedules.

ASSURED LOW COST. Your oxygen is available fast . . . at a firm contractual price that reflects the economies provided by Airco's large resources and long experience.

For the full oxygen story, write, wire or phone today.

AIRCO®

AIR REDUCTION

150 EAST 42nd STREET · NEW YORK 17, NEW YORK

Making ammonia

One of two 1500-hp Ingersoll-Rand KVGA turbocharged gas-engine compressors at Federation Chemicals Limited in Point Lisas, Trinidad. Each unit compresses 591 cfm of ammonia synthesis gas in four stages to 5000 psi.

nia under tropical skies

Five types of I-R compressors handle all processes in new Trinidad ammonia-urea plant

The new ammonia-urea synthesis plant of Federation Chemicals Limited, managed and operated by W. R. Grace & Co., has gone into production at Point Lisas, Trinidad, with five different types of Ingersoll-Rand reciprocating compressors handling all air and gas applications. The startup was successful and on time – typical of I-R equipment and service.

The I-R equipment includes two 1500-hp KVGA turbocharged gas-engine compressors handling synthesis gas in four stages at 5000-psi discharge. Two 330-hp SVG gas-engine units compress carbon dioxide to 3000 psi, and two 660-hp SVG's handle ammonia refrigerant and air. A 75-hp electric-driven ESH horizontal compressor provides 100-psi general-service air, and a 40-hp ESH supplies instrument air. A single-stage 183-hp electric-driven HHE circulator operates at 4700-psi discharge. There is also a 10-hp Type 30 single-acting air-cooled compressor.

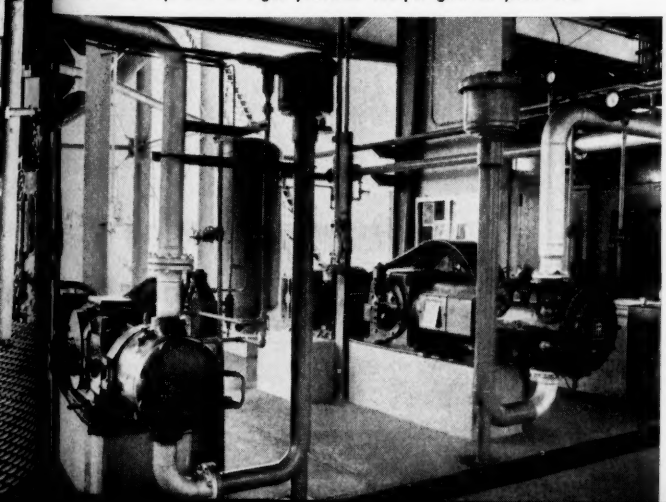
The Trinidad plant employs 15 Ingersoll-Rand centrifugal pumps on various services.

Ingersoll-Rand equipment may be found in all types of jobs, around the world. I-R offers the most complete line of compressors, in reciprocating, centrifugal, rotary and ejector types. There are units from ½ to 20,000 hp, for pressures from one micron to 35,000 psi. I-R is also the world's biggest builder of centrifugal pumps. Your I-R man can give valuable help with your process – call him today.

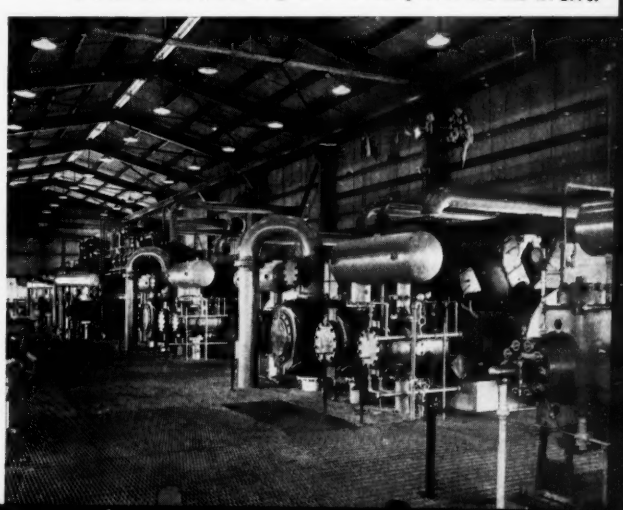
Ingersoll-Rand

153A14 ♥ 11 Broadway, New York 4, N. Y.

Two Ingersoll-Rand ESH motor-driven compressors at Federation Chemicals. The 40-hp unit at left supplies air for instrumentation, and the 75-hp unit at right provides 100-psi general plant air.



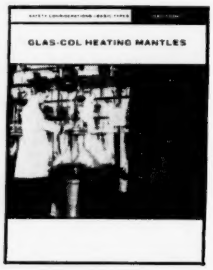
Two 330-hp SVG gas-engine compressors handling carbon dioxide. A cylinder of a 660-hp SVG which handles ammonia refrigerant and air can be seen at right. In the background are the KVGA's.



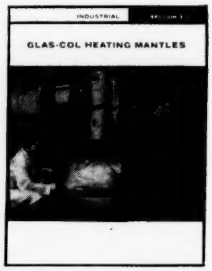
Just published by Glas-Col

Complete new guide to electric heating mantles

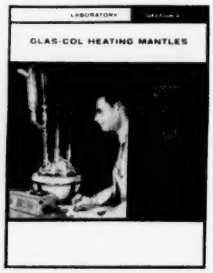
Written for laboratory directors, plant managers, design engineers, safety directors...*in 4 separate sections*



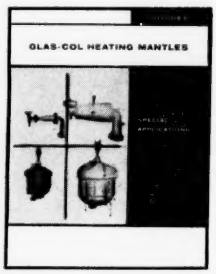
Section 1 Basic types of heating mantles . . . safety considerations . . . how *not* to use heating mantles.



Section 3 Industrial-scale mantles for glass-lined steel vessels . . . heating chamber blankets . . . drum heaters . . . pipe line heating tapes.



Section 2 Laboratory mantles made of glass fabrics for safe operation to 450°C and quartz fabrics (650°C) for flasks, beakers, funnels, vacuum vessels, evaporating dishes, bottles and jars . . . heating tops . . . mantles for columns and for Soxhlet, Kjeldahl and micro flasks . . . heating tapes and cords . . . electrical controls . . . mantle supports.



Section 4 "Custom" mantles for special applications.

Glas-Col Apparatus Company

Dept. CR, 711 Hulman Street, Terre Haute, Indiana

World's largest manufacturer of heating mantles for laboratory, pilot plant and chemical process heating applications.

Use this coupon to request sections you want . . . all four if you desire!

GLAS-COL APPARATUS COMPANY
Dept. CR, 711 Hulman Street,
Terre Haute, Indiana

Please send

- ☐ Section 1—Introduction to Heating Mantles
- ☐ Section 2—Laboratory-type Heating Mantles
- ☐ Section 3—Industrial-scale Heating Mantles
- ☐ Section 4—Mantles for Special Applications

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

Trademark Reg. U.S. Pat. Office. U.S. Patents 2,231,506; 2,282,070; 2,739,220; 2,739,221

Glas-Col makes the world's most complete line of electric heating mantles

– for laboratories

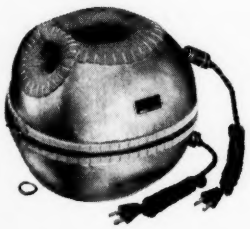
– for pilot plants

– for industrial chemical processing

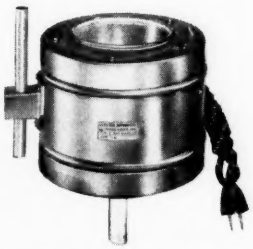
Since their introduction in 1939, Glas-Col Electric Heating Mantles have become recognized as standard equipment for heating and distillation of flammable chemicals. Nearly half-a-million have been built—and *not a single fire has ever been reported from their use!*

Heating mantle applications now extend beyond the laboratory into . . . plant-scale production of pharmaceuticals • production of very high purity chemicals in all-glass equipment up to 200-liter capacity • zoned heating of glass-lined steel kettles • atomic research • pipe line heating.

Glas-Col heating mantles can be applied to virtually any chemical heating apparatus, including special, highly complex equipment. All requests handled in complete confidence.

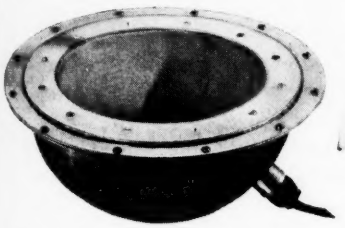


Spherical Mantle for a Two-Neck Flask

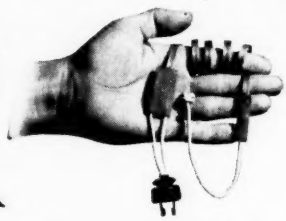


Mantle for fritted disc Buchner funnel

Glas-Col heating mantle for giant 200-liter flasks in all-glass pharmaceutical plant



Series S Quartz-Fabric Electric Heating Mantle



Laboratory-type Double-Element Heating Tape

Glas-Col electric heating mantle specially designed for 150-gal glass-lined steel kettle

Glas-Col Apparatus Company

GLAS-COL APPARATUS COMPANY
Dept. CR, 711 Hulman Street,
Terre Haute, Indiana

Trademark Reg. U.S. Pat. Office. U.S. Patents 2,231,506; 2,282,078; 2,739,220; 2,739,221

FOR QUALITY... PRODUCTIVITY ...PROFIT

INSTRUMENTATION FOR AUTOMATION

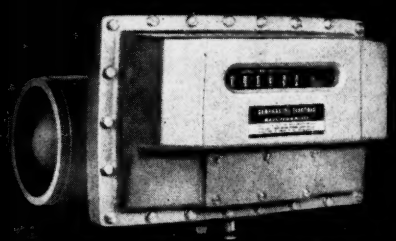
PROBLEM: how to collect, record and transmit critical fluid flow data more *accurately* than ever before.

SOLUTION: custom-designed flow measurement systems from General Electric.

RESULT: reliable process control, simplified fluid accounting, precision batch blending and loading.

System instrumentation includes: true mass flowmeter, available in 13 standard ranges ■ null balance recorders, a full line of strip and round-chart ■ new telemetering equipment, analog and digital.

In addition, ticket printers and totalizing counters are available for visual digital display and pre-set counters may be added to provide precision control in blending and loading operations.



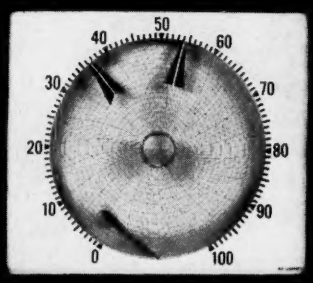
Mass Flowmeter measures fluid flow directly in pounds, eliminates volume-to-mass conversion. ±1% accuracy unaffected by change in pressure, density, temperature, viscosity, flow rate. 13 standard ranges now available.

FOR FLUID FLOW PROCESS:

HIGH ACCURACY M

In a variety of system applications, these General Electric instruments cut operating costs and boost plant production . . . through *simplified* and *more accurate* measurement. No wonder they've been specified by process engineers throughout the world. *Performance-proved . . . on the line!*

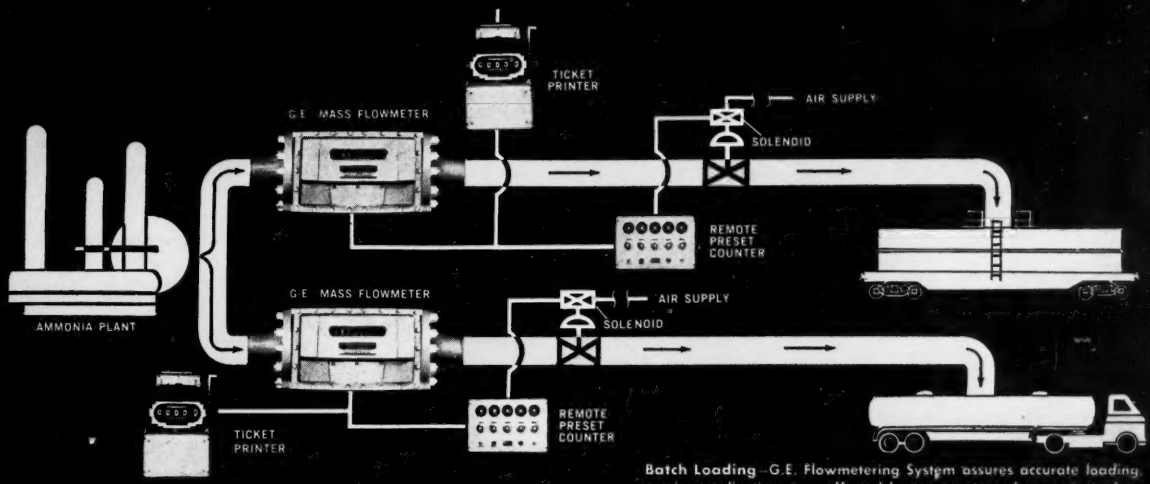
For complete information, contact your nearby General Electric sales office or write Section 599-08, General Electric Co., Schenectady 5, N. Y. for the following bulletins: GEA-6925, Mass Flowmeter; GEA-6887, Null Balance Recorders; GEA-7163, Telemetering Systems. In Canada, contact Canadian G.E. Co. Ltd., 940 Lansdowne Ave., Toronto 4, Ontario. Outside the U.S. and Canada, contact International G.E. Co., 150 E. 42nd St., New York 14, N. Y.



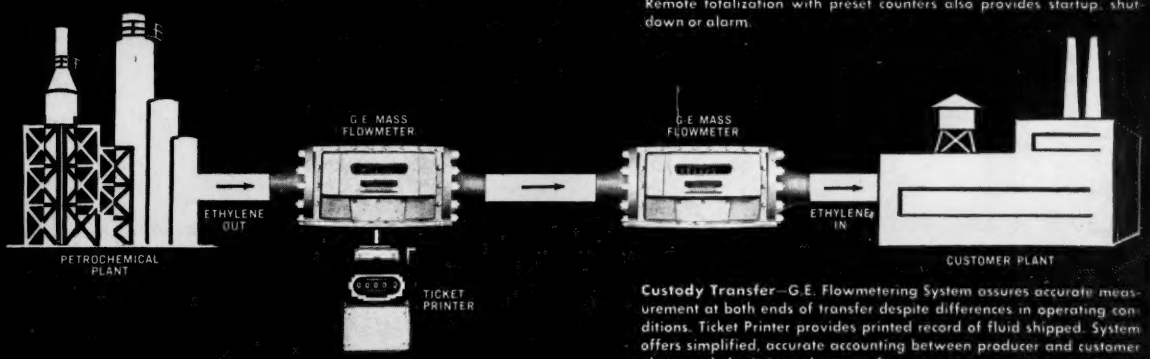
General Electric Null Balance Recorders feature silicon diode reference voltage source for operational reliability; varied control forms for versatile applications; components mounted on swing-out panel to simplify routine maintenance. Full line includes multipoint, single and two-pen strip or round-chart models.

INSTRUMENT DEPARTMENT

GENERAL ELECTRIC

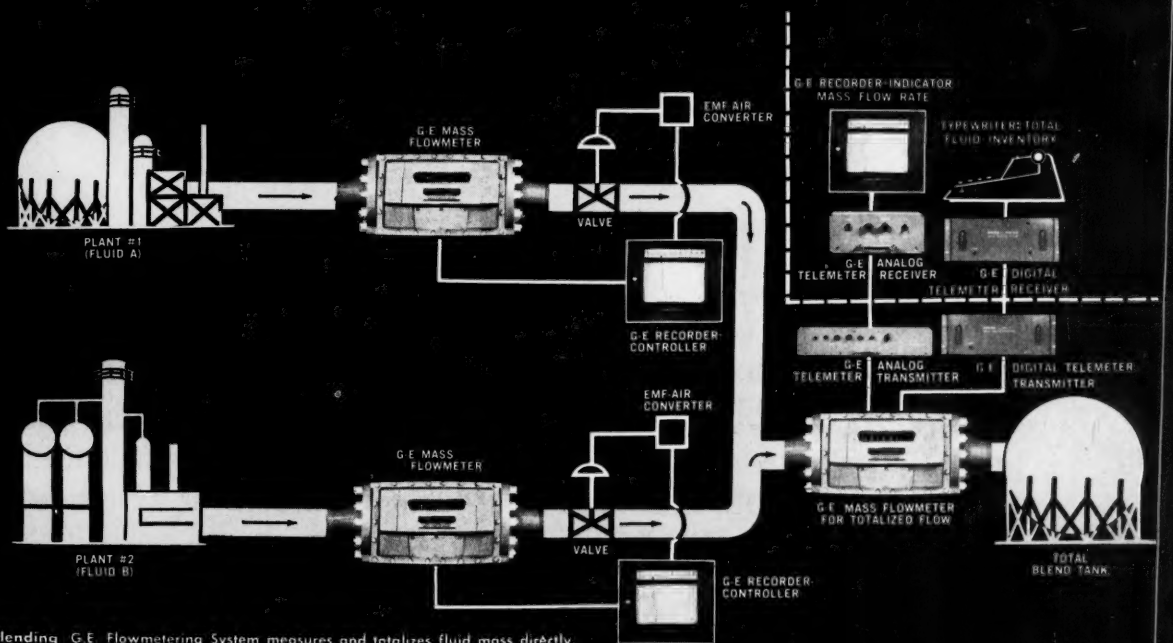


Batch Loading—G.E. Flowmetering System assures accurate loading, precise totalization, is unaffected by temperature changes in tank or pipe. Meter measures different fluids with no calibration change. Remote totalization with preset counters also provides startup, shutdown or alarm.



Custody Transfer—G.E. Flowmetering System assures accurate measurement at both ends of transfer despite differences in operating conditions. Ticket Printer provides printed record of fluid shipped. System offers simplified, accurate accounting between producer and customer plants and also in interplant transfers.

MEASUREMENT SYSTEMS FROM GENERAL ELECTRIC



Fluid Blending—G.E. Flowmetering System measures and totalizes fluid mass directly, eliminates laborious volume-to-mass conversions. Predetermining counters assure simplicity and accuracy in blending operations. Data is instantly telemetered to central locations by new G-E Telemetering. Typical blends are refrigerants, solvents and special naphthas.

US RUBBER

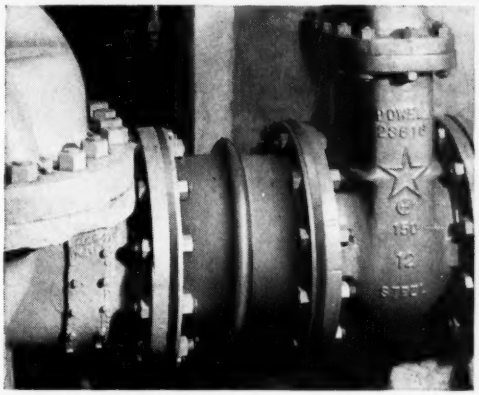
AT THE HEART OF INDUSTRY...

Union Carbide's Uravan Mill's need for flexible piping that stood severe abrasion without being chewed up was filled by U.S. Pilot® Pipe. This pipe is built to handle abrasive and corrosive materials such as calcined ore and sulfuric and hydrochloric acid. It's flexible, easy to install, won't build up . . . gives longer service life than metal pipe.

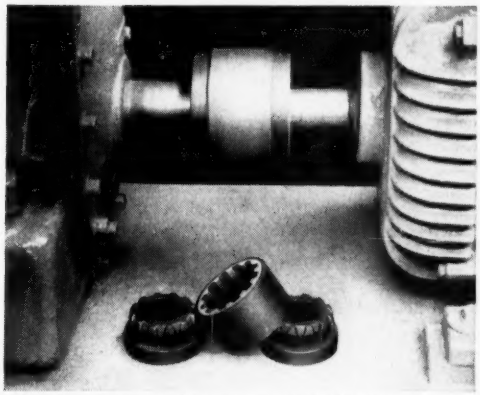
H 121

Wherever industry produces, processes, or transports chemicals or chemical solutions, you'll find US Industrial Rubber Products helping to minimize maintenance, maximize efficiency and profits. Look to US, the world's largest manufacturer of Industrial Rubber Products, to fill all your rubber needs.

Protecting St. Lawrence Seaway dredges, U.S. Permobond® lining guards the dredging pipes against abrasive action and oil. Permobond also stops corrosion in the main shafts when the dredge works in salt water. The result is longer pipe and shaft life, minimum maintenance, maximum efficiency. Permobond was selected because of its known superiority to any other type of lining.
TL 102



Name your chemical, name your processing temperature, and you'll get a customized U.S. Chemex Expansion Joint designed to operate on your piping with maximum efficiency. Neither flow surge, pressure, temperature, nor corrosive action will cause money-losing down-time when your processing equipment is protected by chemical-resistant U.S. Chemex Expansion Joints.
EJ 103

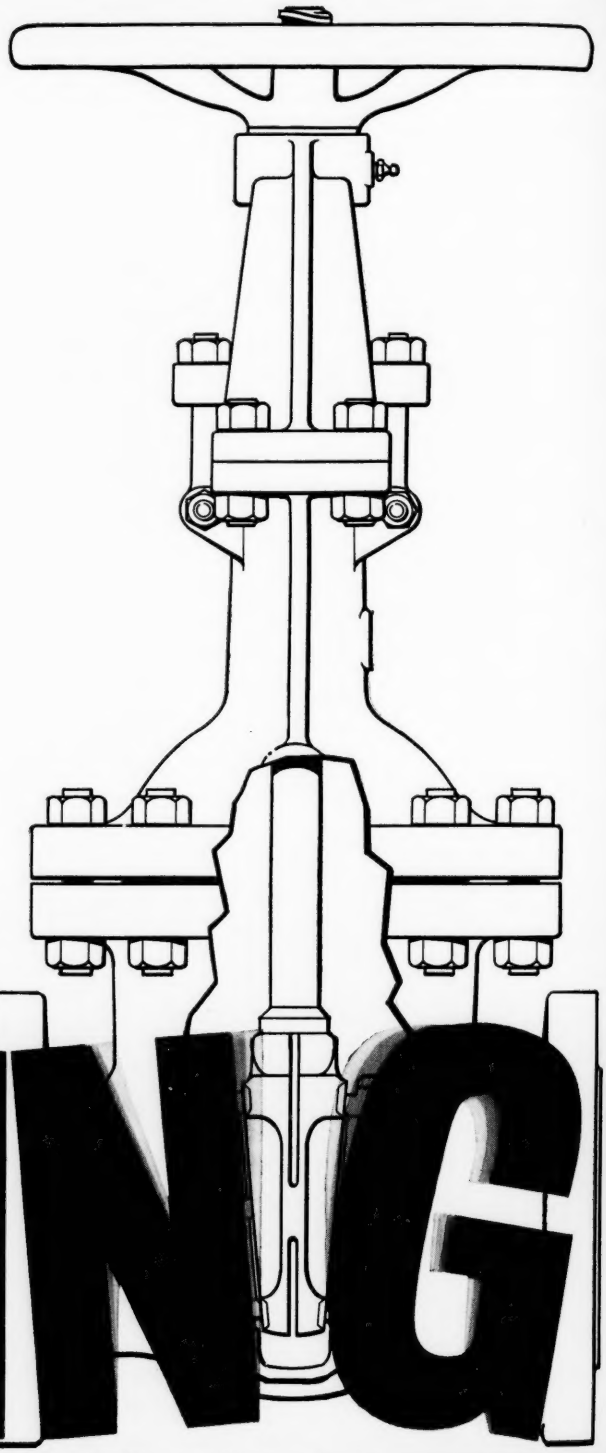


The low cost and ease of installation of U.S. PowerGrip Flexible Couplings please P. H. Glatfelter Paper Company. This company also likes the way these couplings compensate for shaft misalignment, absorb sudden shocks with ease. PowerGrip Couplings have a built-in clutch action for "give" in case of overload, prevent damage to machinery, require no maintenance.
FC 102

For every industrial rubber product need, turn to US. For Conveyor Belts, V-Belts, the original PowerGrip "Timing"® Belt, Flexible Couplings, Mountings, Fenders, Hose and Packings . . . custom-designed rubber products of every description. Discover why U.S. Rubber has become the largest developer and producer of industrial rubber products in the world. See your U.S. Rubber Distributor or contact US directly at Rockefeller Center, New York 20, N. Y.

WORLD'S LARGEST MANUFACTURER
OF INDUSTRIAL RUBBER PRODUCTS

United States Rubber
MECHANICAL GOODS DIVISION



LIVING G

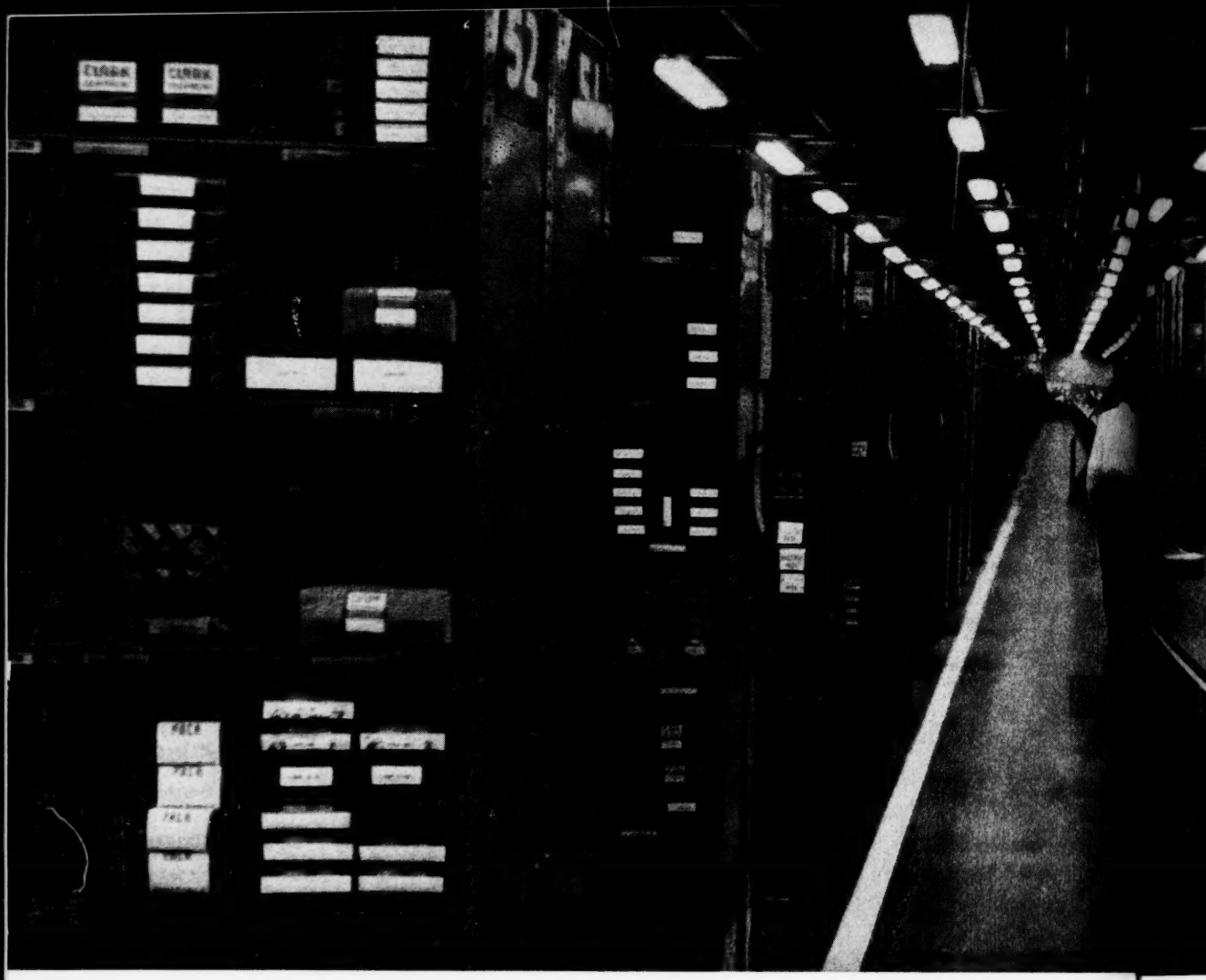
Walworth's last word in positive sealing! When valve bodies are tortured out of shape by line pressure, temperature or deflection—new Walworth living wedge Gate Valves still seal tight! It's because of Walworth's unique one-piece split disc gate that lives in the body...flexes and gives, to stay mated to the seat in spite of body distortion. Yet new Walworth living wedge Gate Valve operates at low torque, can't bind, jam or stick—and is economical, needing

WEDGE

minimum replacements. Get new Walworth living wedge Gate Valves in 150 and 300 pound ASA ratings, 2″ to 24″. See your Walworth distributor for details, or write to Walworth Company, 750 Third Avenue, New York 17, N. Y.

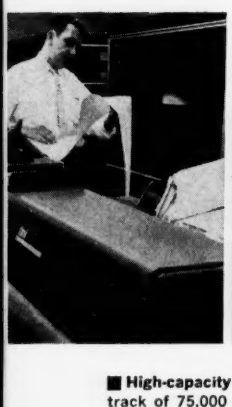
WALWORTH

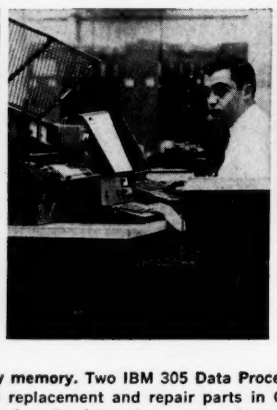
the Walworth companies: Alloy Steel Products Co.—Conoflow Corporation—Grove Valve and Regulator Co.—M & H Valve and Fittings Co.—Southwest Fabricating & Welding Co., Inc.



Inventory Management Simulator program at...

Clark Equipment... improves custome





■ **High-capacity memory.** Two IBM 305 Data Processing Systems with RAMAC keep track of 75,000 replacement and repair parts in Clark's Chicago parts warehouse. ■ **The computer has the facts.** As soon as shipments arrive at the warehouse, an operator, using this remote inquiry station near the loading platform, finds out from the computers where various items go. ■ **Customer service first.** Using this remote inquiry station in the sales department, the operator gets information from the computer while the customer is on the phone.

Clark Equipment Company has prepared a co
puter program called an Inventory Manag
ment Simulator. The program allows Cl
management to study the possible effects of
cisions on future customer service and fut
warehouse profitability. When manageme
gets the computer's report, it is in a position
make new rules for the operation of its pa
warehouse.

Here's what's happened since Clark put t
new program into operation:... improved c
tomer service... practically eliminated ba
order problem . . . reduced the putaway ti
for incoming material by more than 50 per c
. . . reduced emergency order shipping time
50 per cent . . . enabled a physical inventory
be taken without any interruption of servi
to customers.

ne ervice...with less inventory

vailability highest ever. Inventory management a complex job at Clark. Its Chicago warehouse is one of the busiest and largest in the untry. Before the Simulator program was veloped, the warehouse carried an inventory 85,000 individual replacement and repair rts. Use of the program helped transfer the vestment in inventory to those parts most equently called for, giving high availability ith less investment.

anagement Operating System.* Clark installed o IBM 305 Data Processing Systems with AMAC.® These computers store, update, and er on an instant's notice information on alost every aspect of the warehouse operation cluding complete information on every one of e 75,000 items maintained in stock.

Now, Clark is assured of maintaining just the right level of stock for each item. The procurement formulas, developed from the Inventory Management Simulator, even recommend how large a purchase order should be placed for each item and where it should be placed.

If you have an inventory problem, why not consider a simulation program? You don't have to have your own computer. We can supply you with an Inventory Management Simulator...you can rent time on a computer. Result...improve the profitability of your warehouse operation.

**A Management Operating System uses IBM computers to make routine business decisions and take action automatically ...flags problems that need management's special attention... frees management to concentrate on the big problems and on long range planning. As a result, it gives tighter control of all business operations...and helps cut costs.*

IBM®
DATA PROCESSING

Fulflo

Honan-Crane

Delpark

Michiana

YOUR BEST CHOICE IN FILTERS FOR THE CHEMICAL PROCESSING INDUSTRIES

CFC filter uses in the chemical industry range all the way from Alcohol to Xylene. At one leading plant CFC equipment is filtering 400 different organic chemicals; at another cryogenic fluids; at still another CFC filters are wax dehazing lubricating oil. Whatever the chemical application, CFC has the *right* filter.

CFC filters are the choice of the chemical industry because they have been proven under diversified and critical operating conditions . . . because CFC has 25 years of design engineering experience in the chemical field . . . in short because the industry can be sure that a CFC filter is the best filter available, at the lowest cost.

CFC

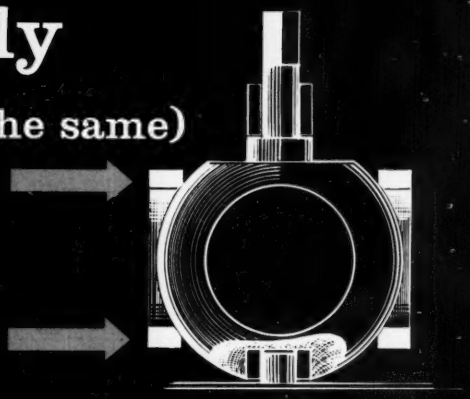
COMMERCIAL FILTERS CORPORATION

Dept. CE **MELROSE 76, MASSACHUSETTS**

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

Look closely

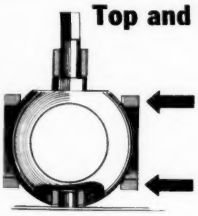
(not all ball valves are the same)



..this top and bottom guided **FLO·BALL**® has revolutionized valving!

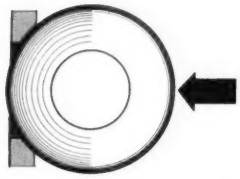
Only **FLO·BALL** has a top and bottom guided ball combined with top entry. These features, which give you best valve performance, make all other ball valves obsolete. **FLO·BALL** is the valve you will use today **and** for years to come. Only **FLO·BALL** offers all this at a competitive price.

Top and Bottom Guided *FLO·BALL*



Unlike other ball valves, **FLO·BALL** seats do not serve as bearings. By putting the bearing loads where they belong — on frictionless Teflon bearings — the seat can then perform its basic sealing function. Result: longest seat life, lowest torque, in sizes through 36", pressures to 10,000 psi, temperatures from cryogenic (−423° F) to + 500° F, for on-off and throttling.

Floating Ball Valves



Other makes of ball valves put the crushing burden of bearing loads right on the fixed seats. This results in seat distortion, hard turning and short life.

Fill in reverse side and mail today!

For ultimate valve performance, specify FLO • BALL — no equal!

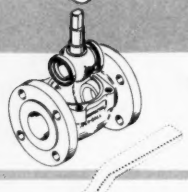
Business Reply Mail
No Postage Stamp Necessary if Mailed in the U.S.

FIRST CLASS
PERMIT #471
BLOOMFIELD
NEW JERSEY

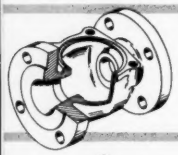
Postage Will Be Paid By

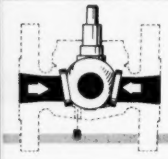
HYDROMATICS, Inc.
Bloomfield, New Jersey

Compare FLO•BALL® feature for feature
...there is no equal!



	FLO-BALL	Ball Valve A	Ball Valve B	Ball Valve C	Ball Valve D	Ball Valve E
1. TOP ENTRY All internal parts can be removed and re-installed without removing valve from line.	√			√		
2. TOP AND BOTTOM GUIDED BALL Provides truly double seal, extends seat life. Makes for easy operation.	√					
3. DOUBLE SEATS Interchangeable and replaceable seats insure sealing in both directions; give double protection against leakage.	√	√	√	√	√	√
4. FLANGES INTEGRAL WITH BODY Rugged, one-piece body design gives greatest possible strength.	√	√		√		
5. ONE PIECE BALL AND STEM No possibility of separation of ball from stem. Always perfect alignment with zero backlash. Foolproofed for assembly.	√					
6. BLOCK AND BLEED Top and bottom guided ball and floating seats provide simultaneous up-stream and down-stream seal . . . a true block and bleed valve. Block and bleed type available on special order.	√					





Specify the FLO • BALL for your application

	SCREWED ENDS	FLANGED ENDS
Sizes	⅛″ — 2″	1″ — 36″
Pressures	Vacuum — 600 # — 3000 #	150 # — 300 # — 600 # (ASA Rating)
Materials	Carbon Steel, Stainless Steels, Semi-Steel, Brass, Alloy 20, Monel	
Operators	Manual, Hydraulic and Motor	
Your Choice of FLO-BALL Types	Two-Way, Three-Way, Fire-safe, High Pressure (to 10,000 psi), Cryogenic, etc.	

Gentlemen:

I am interested in getting complete information on FLO•BALL valves.

My application is_____.

☐ *Send sales engineer* ☐ *Send literature*

Name_____ Title_____

Company_____

Street_____

City_____ State_____

FLO-BALL

Hydromatics, Inc.

BLOOMFIELD, NEW JERSEY

Fill in this card ... mail today!

Printed in U.S.A. ©1961

ENGINEERS AND CONSTRUCTORS FOR INDUSTRY

New Shawinigan process lowers production cost of hydrogen cyanide

A new hydrogen cyanide process, developed by Shawinigan Chemicals Ltd. of Canada and available through The Lummus Company, produces HCN from ammonia and hydrocarbon (methane or propane) in a non-catalytic, oxygen-free reaction. The process — first commercial application of the "FLUOHMIC"* reactor — offers low production costs and ease of operation.

Yields on hydrocarbon and ammonia exceed 85% with negligible undecomposed ammonia carry-through, simplifying recovery or disposal requirements. Furthermore, valuable high-purity hydrogen by-product is available for use as required.

The Shawinigan HCN process produces hydrogen cyanide competitively using 8 mill power and 25-30¢ per MSCF natural gas. It becomes increasingly attractive in areas of lower power costs or higher cost hydrocarbon. A commercial scale reactor is being operated by Shawinigan Chemicals Ltd.

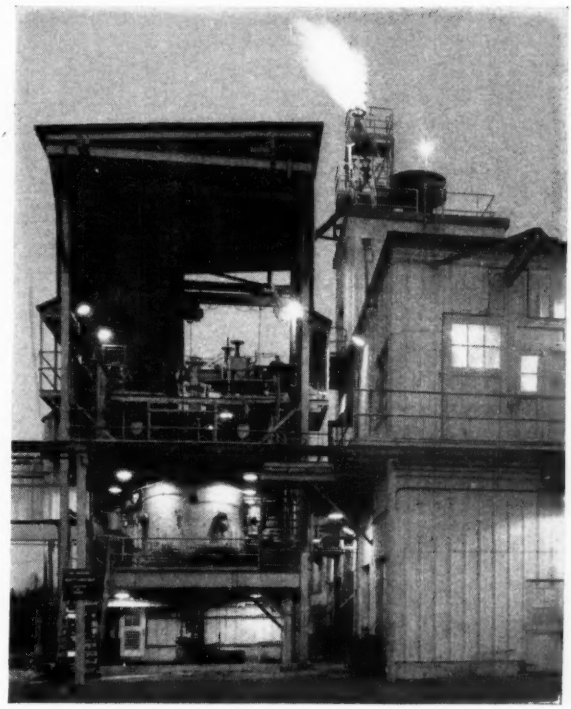
How the Process Works

The reaction system uses a uniquely designed fluidized bed reactor to realize the efficiencies of a very high temperature in the hydrogen cyanide reaction.

The Shawinigan HCN reactor consists of a refractory lined electrically heated vessel. It operates in the range of 2,400 to 3,000° F. at essentially atmospheric pressure. A non-consumed fluidized bed of coke particles is heated by electrical conduction. The reactor design achieves an extremely uniform high temperature throughout the reaction zone. At these very high temperatures the significant improvement in conversion rates — compared with conventional processing — results in a high concentration of product in the effluent gas. The effluent gas is cooled and purified by standard methods.

Process Advantages

Some major advantages of this process are: (1) Absence of water from the effluent gas. This eliminates the problem of tarry polymer formation in the cooling and recovery section. (2) Considerable reduction in unreacted ammonia in the effluent gas. This eliminates the problem of recovery or disposal of unreacted ammonia. A typical carry-through ammonia content would be 0.3 volume % on net reactor effluent. (3) Greatly reduced stringency in feed-stock purity requirements. This is a natural result of the elimination of catalysts from the process. (4) Flexibility in choice of hydrocarbon feed. L.P.G. can be used where natural gas supply is unavailable or interruptible. (5) Operating rates are flexible. Units will perform well at rates as low as 25% of capacity. (6) High concentration of HCN in the reactor effluent. This may be 5-6 times as high as in present commercial processes.



View of the Hydrogen Cyanide Reactor in operation at The Shawinigan Chemicals Limited Cyanide Plant.

For further details on this process, contact your nearest Lummus office.

*Trademark — Shawinigan Chemicals Limited

THE LUMMUS COMPANY, 385 Madison Avenue, New York 17, New York, Houston, Washington, D. C., Montreal, London, Paris, The Hague, Madrid; Engineering Development Center: Newark, N. J.

Now get greater flow capacitywi Hammel-Dahl split-bodyco

CHOOSE FROM THIS COMPLETE LINE OF INTERCHANGEABLE ACTUATORS

POSITIONING PISTON ACTUATOR
(Direct or Reverse)

ON-OFF PISTON ACTUATOR
(Reverse; Direct Available)

HYDRAMOTOR ACTUATOR
(Electro-Hydrau

TORK-MAST ACTUATO
(Electric Gear-Drive

See how much more flow capacity you get with Hammel-Dahl Division split-body control valves. Compare these Cv ratings with other valves now available. Prove for yourself: Hammel-Dahl "S" Style bodies have higher capacities than any conventional split-body design; Hammel-Dahl "Y" Style bodies set new standards for Cv per nominal pipe size.

This can mean substantial savings for you. You get more flow for your valve dollar . . . and more valve with Hammel-Dahl quality design!

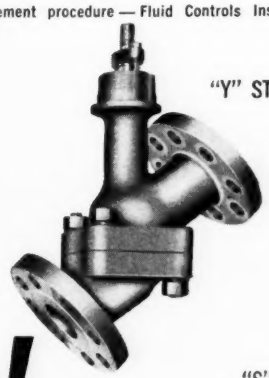
Remember, too, variety in split-body styles typifies the choice you get from Hammel-Dahl for all your valve requirements: Globe, Angle, Three-Way, Microflo, Saunders Patent, Butterfly, or Special designs.

tywith NEW
dycontrol valves!

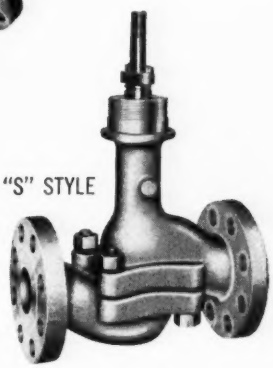
Look at these Flow Coefficients (Cv)*
Integral flanges choice of: face-to-face dimensions and actuator types.

Size	1"	1½"	2"	3"	4"
On-Off	20	60	105	244	400
Throttle	18	50	100	225	380

*Flow capacity measurement procedure — Fluid Controls Institute Recommended Standard 58-2.



"Y" STYLE

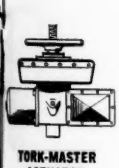


"S" STYLE

Look at these Flow Coefficients (Cv)*
Choice of: separable or integral flanges, actuator types, face-to-face dimensions. Also available: "SL" 90° angle flow pattern.

Size	½"	¾"	1"	1½"	2"	3"	4"
On-Off	4	6.3	13	33	50	135	240
Throttle	4	6.3	13	33	50	135	240

*Flow capacity measurement procedure — Fluid Controls Institute Recommended Standard 58-2.



TORK-MASTER ACTUATOR (Electric, Gear-Driven)

DIAPHRAGM ACTUATOR (9 Types Available)

MANUAL ACTUATOR

Check the yellow pages for your nearest Hammel-Dahl field representative, or write for Bulletin S-B.

Manufacturers of Control Valves and Allied Equipment

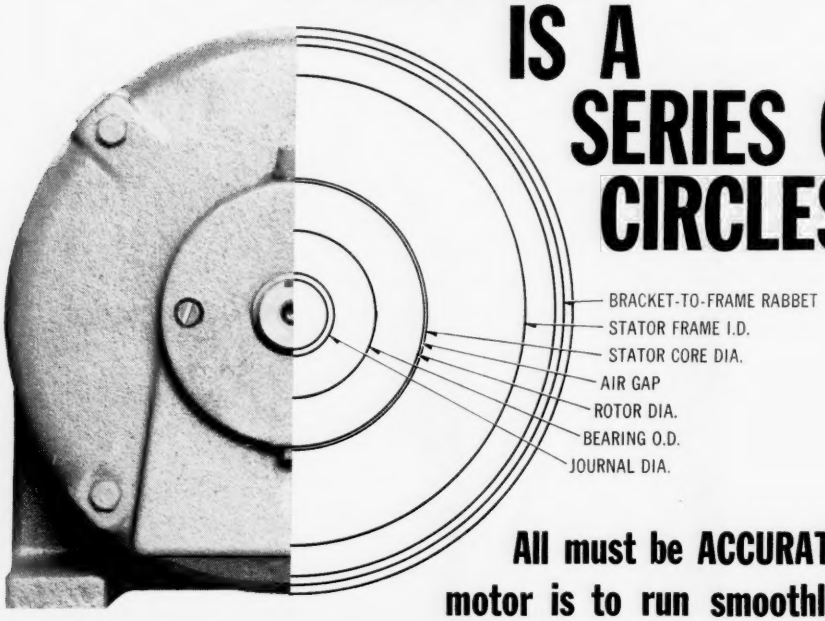
HAMMEL-DAHL DIVISION

GENERAL CONTROLS CO.

WARWICK INDUSTRIAL PARK, WARWICK, RHODE ISLAND • STUART 1-6200

Factory Branch Offices or representatives in principal cities – United States and abroad.

A MOTOR IS A SERIES OF CIRCLES



All must be ACCURATELY CONCENTRIC if the motor is to run smoothly, quietly, trouble-free

CONCENTRICITY of Elliott C-W Motors begins with the bracket-to-frame fit, the reference for all subsequent "circles." Bearing bore and shaft bore are precisely centered within this accurate diameter.

TOLERANCE of 0.0007 in. for the bearing bore is checked by an air gage after finishing in a precision lathe. Master jig assures accurate positioning of bearing, essential to uniform air gap.

Elliott Crocker-Wheeler integral-hp a-c and d-c motors—from smallest to largest—are offered in all conventional enclosures and modifications; with insulation to suit the application, including EPA-SEAL epoxy insulation, for use where conditions are most severe.

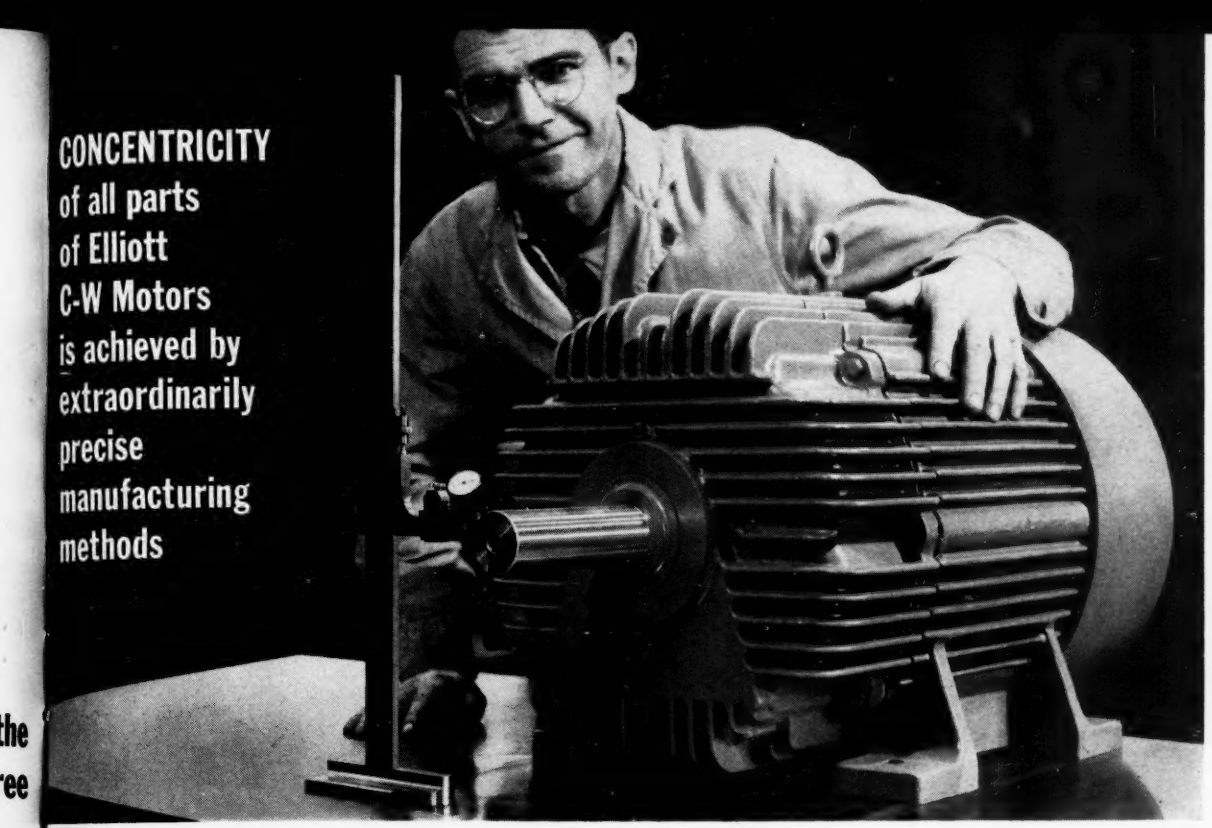
ELLIOTT COMPANY

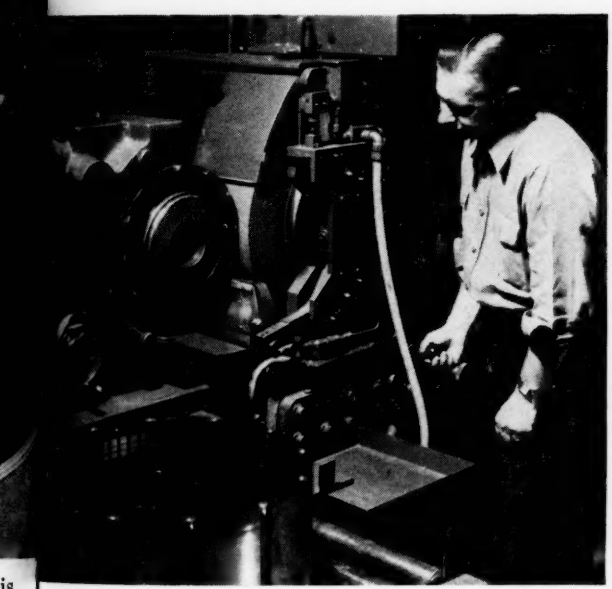
GENERAL OFFICES: JEANNETTE, PENNSYLVANIA

PLANTS AT: Jeannette and Ridgway, Pa.; Springfield, Ohio

TURBINES · GENERATORS · MOTORS · COMPRESSORS · TURBOCHARGERS · EJECTORS · STRAINERS · TUBE CLEANERS

CONCENTRICITY of all parts of Elliott C-W Motors is achieved by extraordinarily precise manufacturing methods

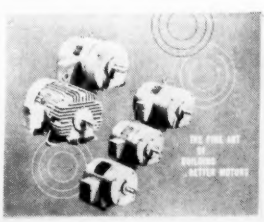




PRECISION GRINDER finishes the outer surface of the stator core to a tolerance of 0.001 inches. It is then pressed and keyed into stator frame, which has been finish machined concentric with the basic bracket-to-frame fit.

DUPLICATING the basic bracket-to-frame fit, a jig accurately positions the wound stator for finishing the inside core diameter by a "fly cutter," which corrects for all accumulated tolerances and assures precise concentricity.

Key manufacturing operations employed in maintaining the required close tolerances are described more completely in an interesting brochure, *The Fine Art of Building Better Motors.* We will be very glad to send you a copy.



W1-2

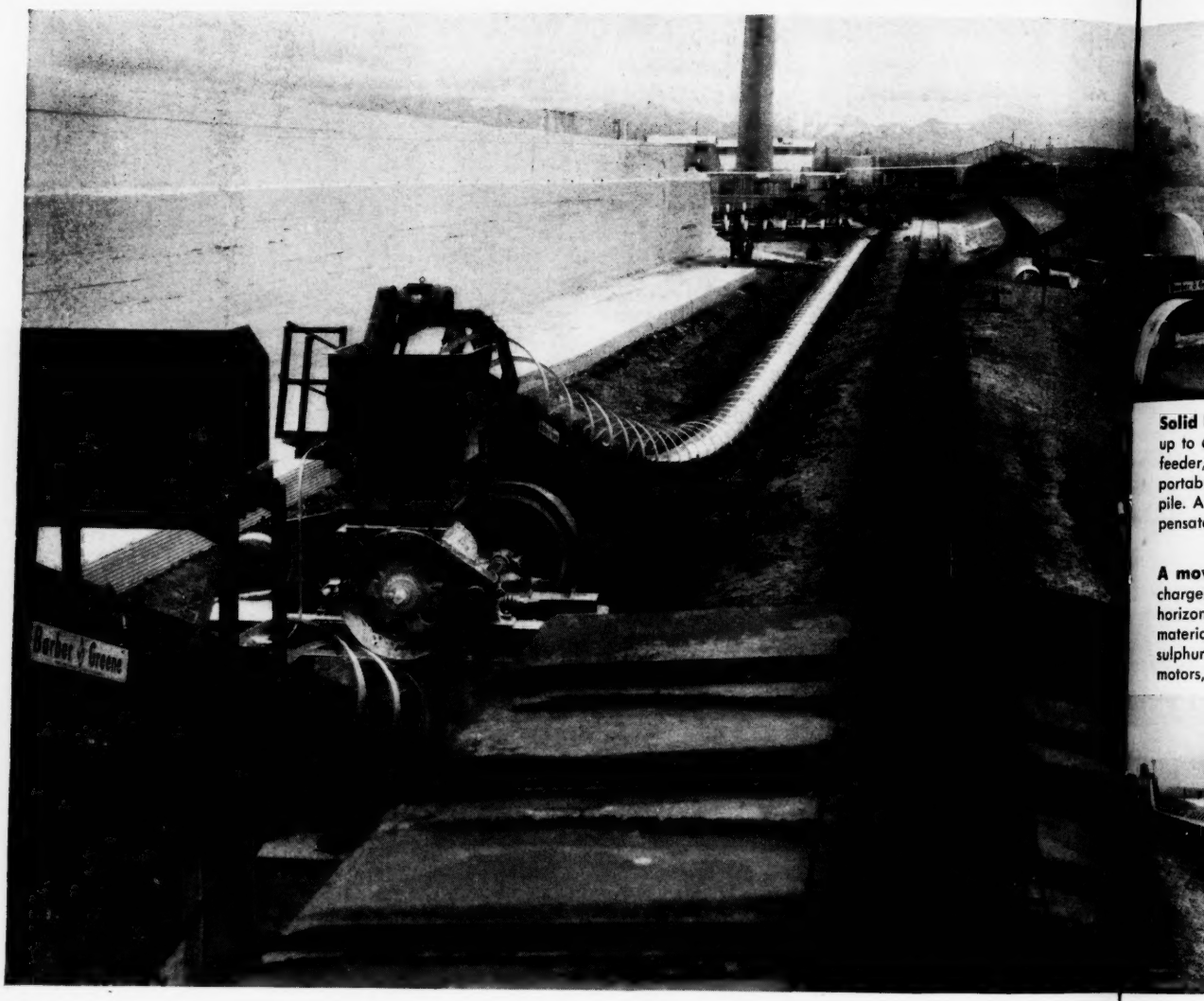
CE

ELLIOTT COMPANY, Jeannette, Penna.
Advertising Department

Please send a copy of *The Fine Art of Building Better Motors* to:

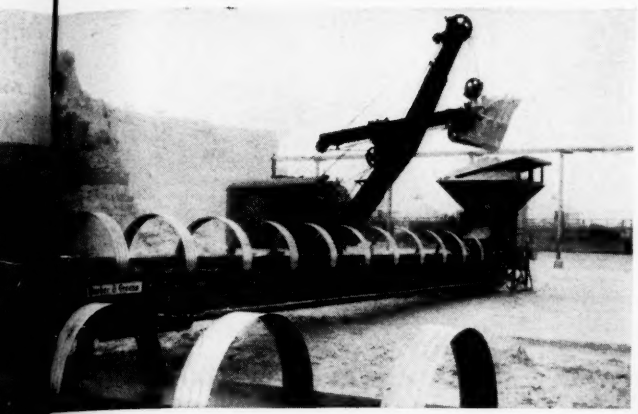
Name_____ Position_____

Company_____



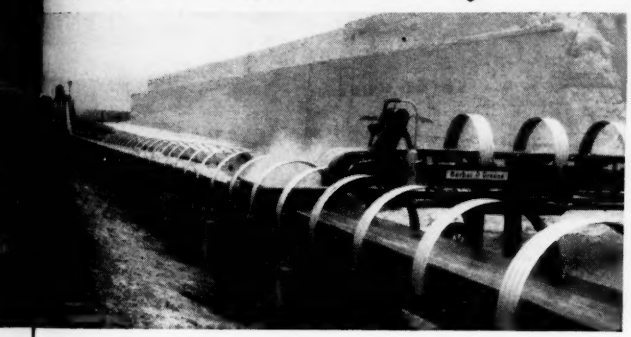
SIMPLIFIES SULPHUR HANDLING, CAR LOADING WITH FLEXIBLE BARBER-GREENE SYSTEM

The British American Oil Company Limited successfully markets sulphur, a co-product of their natural gas processing plant at Pincher Creek, Alberta



Solid blocks of sulphur are 20 feet high, 100 feet wide and up to 600 feet long. Portable conveyor, with portable hopper-feeder, follows the shovel as it eats into the face. Three of these portables extend reclaim operations to any point in the stock-pile. A simple adjustment on the portable conveyor truck compensates for variations in ground elevation.

A movable loading hopper, into which the portable discharges, can be spotted anywhere on the conveyor. The 500-ft. horizontal-inclined conveyor discharges to a roll crusher where material is reduced for easier loading. Hazardous nature of sulphur dust calls for explosion-proof construction of all electric motors, motor controls, push-button station, etc.



An automatic weighing device on the loading conveyor accurately records the amount of material delivered to each section of the boxcar. The loader can be directed from one end of the car to the other, until an even load of pre-determined capacity is reached. The loader is mounted on a retractable frame for moving in and out of the car, and the counterweighted chute quickly swings clear after loading.

Natural gas from B-A's Pincher Creek field has to be scrubbed before it can be marketed. One of the co-products of this scrubbing operation is a high-purity liquid sulphur, which is pumped into vats, solidifies, and becomes a huge stockpile of solid material. The sulphur is then crushed and loaded into railcars on a spur adjacent to the stock-piles and shipped to North American and export markets.

Key factor of efficiency in the operation is a custom conveyor installation, designed and built by Barber-Greene engineers. This highly flexible system includes a 36″ x 500′ horizontal-inclined conveyor served by one of three 36″ x 60′ portables. The portable conveyors range along the stockpiles, feeding 300 tph into a movable loading hopper, which is relocated as required on the main conveyor. The unscreened material, containing up to 12-inch lumps, is discharged into a roll crusher for reduction to minus 4 inches. From the crusher, a 24″ inclined conveyor discharges to a boxcar loader which fills the boxcars to capacity.

When you call on Barber-Greene for tailor-made solutions to your bulk handling problems you get unique engineering features built into the most economical design—and backed by 45 years' experience in the construction of custom conveyor systems.

Let us show you how this experience can bring new efficiency and greater profit to your bulk material handling operations.

MEMBER CEMA CONVEYOR EQUIPMENT MANUFACTURERS ASSOCIATION

Your belt conveyor equipment headquarters

Representatives in Principal Cities of the World

Barber-Greene BG

Main Office and Plant AURORA, ILLINOIS, U. S. A.
Other Plants: DeKalb, Milwaukee, Detroit, Canada, England, Brazil, Australia

CONVEYORS • LOADERS • DITCHERS • ASPHALT PAVING EQUIPMENT

Turbulent liquid layers give remarkable heat transfer in DE LAVAL PLATE HEAT EXCHANGERS

In the past five years, plate heat exchangers have been rapidly outgrowing the limitations of earlier "special" all-stainless applications to become a common replacement for shell and tube units. Extreme compactness, high transfer efficiency, flexibility and trouble-free maintenance have justified this widening use. Installation requires only piping connections.

The benefits of De Laval Plate Heat Exchangers are highlighted here—but you will want to review our "case history" brochure detailing actual processing applications. Write for it, and for our catalog which describes models ranging from 500 to 500,000 lbs/hr capacity.

3 DEGREES OF ECONOMY
open new process possibilities

When the equipment must be all-stainless: At as little as one-third of the cost, including installation, De Laval PHE's do the job better than stainless shell and tubes. Most important, these lower cost and higher efficiencies now permit heat recovery

where th
previous

When
stainless
an instal
shell—ar
benefits.

When
De Lava
unit cos
through
freedom
they are
easily ad
needs, D
way to

THE D
Poughkeep
5724 N. Pul
201 E. Millb
Dept. CE-1

where the cost of stainless shell and tube exchangers previously made it impractical.

When partial-stainless is required: The *all* stainless De Laval PHE is almost always cheaper on an installed cost basis than stainless tubes in a steel shell—and offers many operating and maintenance benefits.

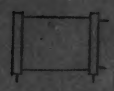
When carbon-steel is satisfactory: Even here, De Laval's all-stainless PHE's can return the higher unit cost through much cheaper installation and through annual savings because of their relative freedom from fouling and easier cleaning. Because they are free from corrosion problems and can be easily adapted or expanded to suit changing product needs, De Laval Plate Heat Exchangers are the *safe* way to handle *any* process heat exchange problem.

THE DE LAVAL SEPARATOR COMPANY

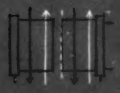
Poughkeepsie, N. Y.
5724 N. Pulaski, Chicago 46, Ill.
201 E. Millbrae Ave., Millbrae, Cal.
Dept. CE-10.

DE LAVAL

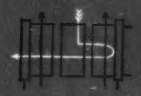
Remarkably compact, the De Laval Plate Heat Exchanger is a series of gasketed corrugated stainless steel plates which are "programmed" for each specific application.



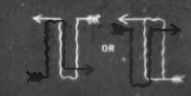
One unit can be compartmented into two or more independent heat exchangers by inserting "connecting" plates.



The component sections can also provide complete regenerative heating and cooling cycles in a continuous flow pattern.

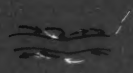


There is great flexibility in design. Plates can be easily positioned for flow patterns that permit a wide range of coolant/product ratios.

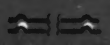


De Laval PHE's are designed for expansion. As the need grows, more exchange capacity is easily and cheaply added.

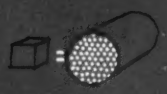
De Laval Plates are corrugated to provide maximum exchange turbulence—even at Reynolds numbers in the 200 range. This is why De Laval Plate Heat Exchangers, area for area, average three times the exchange capacity of tubes.



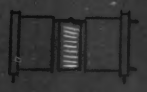
Inert gaskets are recessed in strengthening grooves and withstand pressures to 140 psi and temperatures to 300°F.

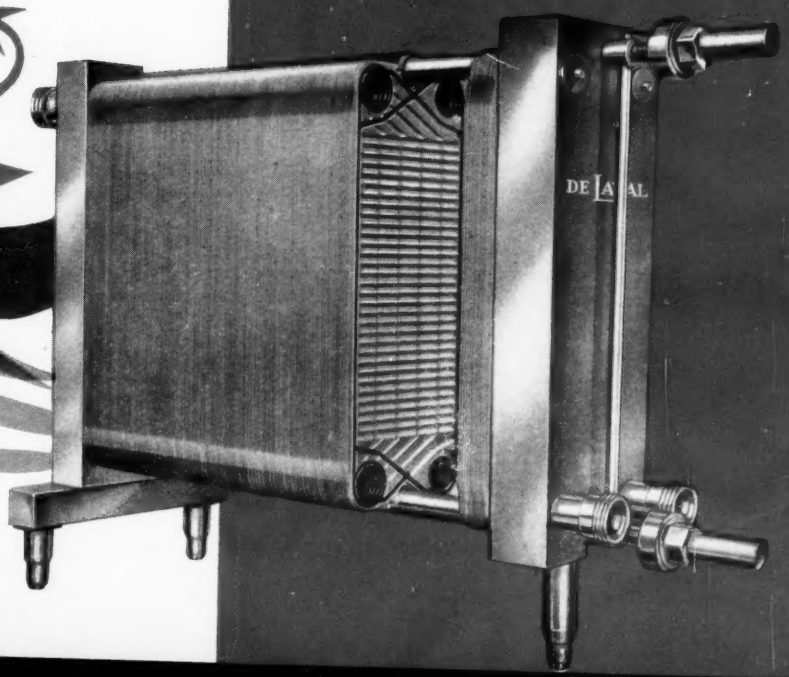


Heat transfer coefficients average 600-800 Btu/Hr°F. ft² and often run to 1000! Coupled with the compact physical design, this means one cubic foot of De Laval plate pack is equal to 4 cubic feet of a typical shell and tube type in providing equivalent heat exchange.



Cleaning of the smooth stainless steel surfaces, if required at all, can very often be done "in place" by reverse flushing with a cleaning solution because of the scrubbing effect of the turbulent flow action. But when used with products that have a natural tendency for fouling, the pack opens in minutes for inspection and cleaning.





Typical control panel at Union Carbide's Institute Plant has over 100 Foxboro Consotrol* indicators, recorders, and controllers.

for Union Carbide's Institute Plant...rapid,

A sprawling chemical metropolis, stretching as far as the eye can see. That's Union Carbide Chemicals Company's Institute, West Virginia plant — producer of Ucon† Fluorocarbon propellants and refrigerants.

Foxboro instrumentation is used to help control 20 of the different processing units at the Institute Plant. Over 10,000 Foxboro indicators, controllers, recorders, and transmitters are used, as well as thousands of Foxboro control valves.

Union Carbide reports favorably on their Foxboro instruments. "In general, we find them easy to work on, easy to repair, easy to maintain." And the company adds, "we appreciate the ability of the Foxboro engineers who work with us."

*Reg. U. S. Pat. Off.

Process is hydraulic — requires fast, sensitive instrument response.

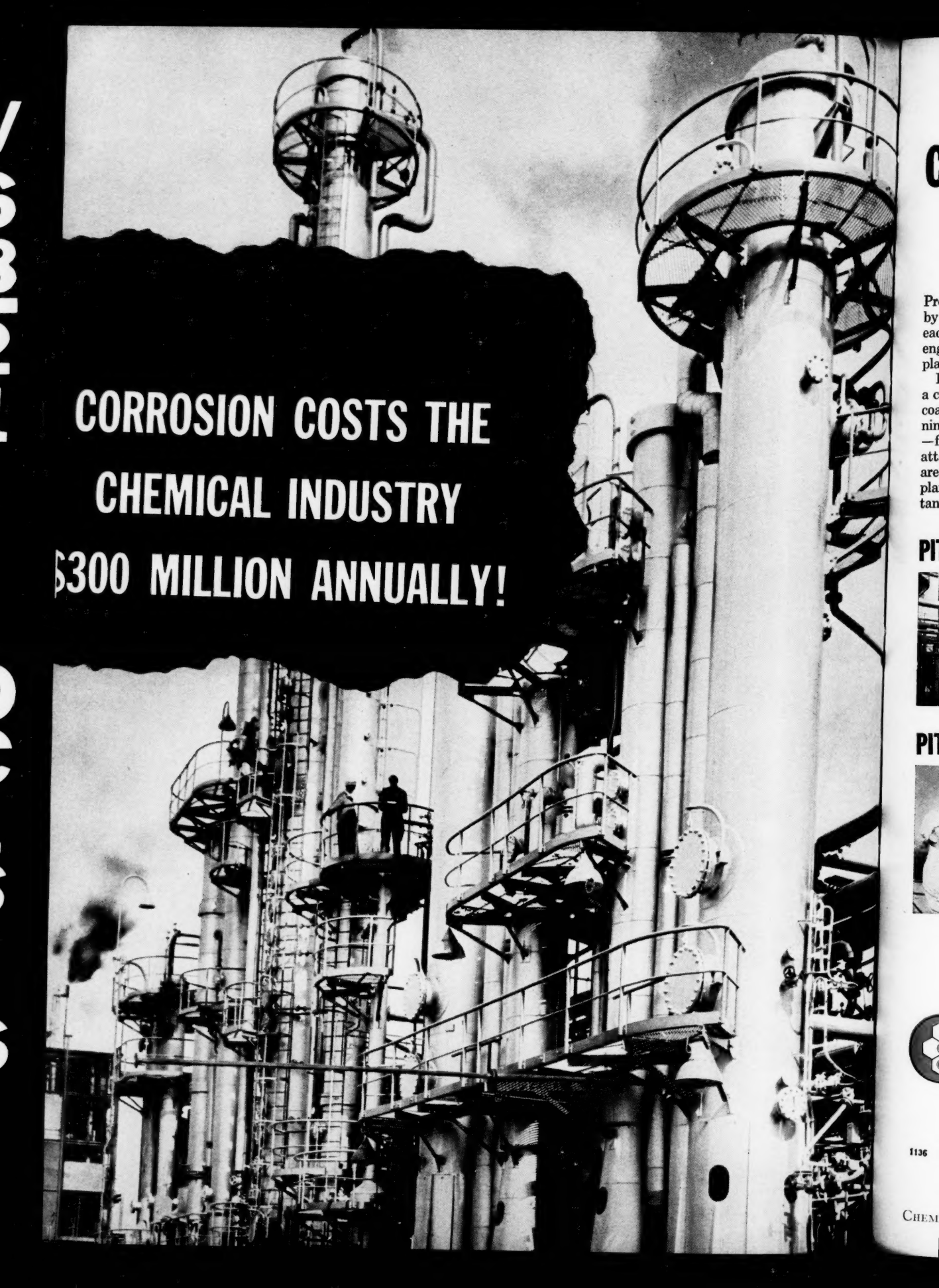
sensitive Foxboro control

You'll like working with Foxboro, too. Unsurpassed instrumentation, both pneumatic and electronic; unsurpassed engineering and service. Ask your local Foxboro Field Engineer for the complete story. Or write for Bulletin 13-18. The Foxboro Company, 3610 Neponset Avenue, Foxboro, Massachusetts.

FOXBORO

REG. U.S. PAT. OFF.

Lab analysis is done right in the control room of this Carbide processing unit. Necessary process adjustments can be made on Foxboro controllers the minute technician detects the need.


CORROSION COSTS THE
CHEMICAL INDUSTRY
$300 MILLION ANNUALLY!

...Now You Can Control 88% of All your Chemical Corrosion Problems with this Proven PITT CHEM® Coating System!

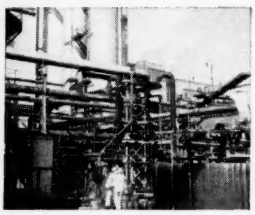
Probably no other industry in the nation is confronted by the variety and severity of corrosion conditions faced each day by the chemical processing industry. Corrosion engineers estimate that the annual toll in equipment and plant facilities is nearly one-third of a billion dollars.

Pittsburgh now provides the chemical industry with a complete *system* of PITT CHEM heavy-duty protective coatings which will efficiently and economically control nine out of every ten corrosion conditions in your plant —from simple atmospheric corrosion to severe chemical attack. Service-proven PITT CHEM cold-applied coatings are now "on guard" in hundreds of chemical processing plants, adding years of valuable service life to storage tanks, piping systems and other equipment where "impossible" corrosion conditions once existed.

PITT CHEM Tarset, Tarmastic and Insul-Mastic are tough, *thick film* coatings that outlast conventional maintenance paints 10 to 20 times. You measure their protection in *decades*, not years. They can be cold-applied by brush, spray gun or roller. No other system of protective coatings can solve so *many* of your corrosion problems so *economically*.

For your personal corrosion data file complete the coupon below and return it today. Then consult your nearest PITT CHEM Distributor—he's listed in the "Yellow Pages." He'll be glad to discuss your corrosion problems with you, and work out a corrosion protection program to meet *your* requirements, without obligation.

PITT CHEM TARSET®



The original, patented coal tar-epoxy coating, Tarset is now solving many of the severest corrosion problems in the chemical industry. Years of service as lining for acid and alkali tanks, and on piping and structural steel, have proven the revolutionary ability of Tarset to withstand extreme chemical corrosion.

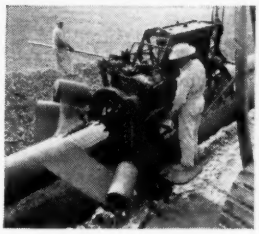
PITT CHEM TARMASTIC®

PITT CHEM Tarmastic coal tar coatings are a series of thick-film protective coatings designed to solve a wide variety of corrosion problems at moderate cost. Excellent for protection of hoods, fans, housing and other equipment against steam and very corrosive vapors, mild acid and alkaline solutions and extreme moisture conditions.

PITT CHEM INSUL-MASTIC®

Vapor and moisture penetration problems are solved economically and effectively with time-tested Insul-Mastic Gilsonite-asphalt coatings. Ideal for the protection of metal, concrete and masonry surfaces against weather, moisture and many chemicals and vapors. Insul-Mastic cork mastics provide good insulating qualities and condensation control.

PITT CHEM PIPELINE ENAMELS



For the long-term preservation of underground pipelines, coal tar enamels are considered the most practical and effective method of protection ever developed. PITT CHEM Pipeline Enamels are widely recognized for their excellent quality and service record on oil, gas and water transmission and distribution lines throughout the nation.

PROTECTIVE COATINGS DIVISION

PITTSBURGH CHEMICAL CO.

GRANT BUILDING PITTSBURGH 19, PA.

A Subsidiary of PITTSBURGH COKE & CHEMICAL CO.

1136

Send for Your Free Copy of this

CHEMICAL CORROSION DATA FILE

Includes a survey of corrosion problems in the Chemical Industry, data on PITT CHEM Coating Systems and a coating selector guide. Write for your copy today.

Protective Coatings Division, Pittsburgh Chemical Co., Grant Bldg., Pittsburgh, Pa.

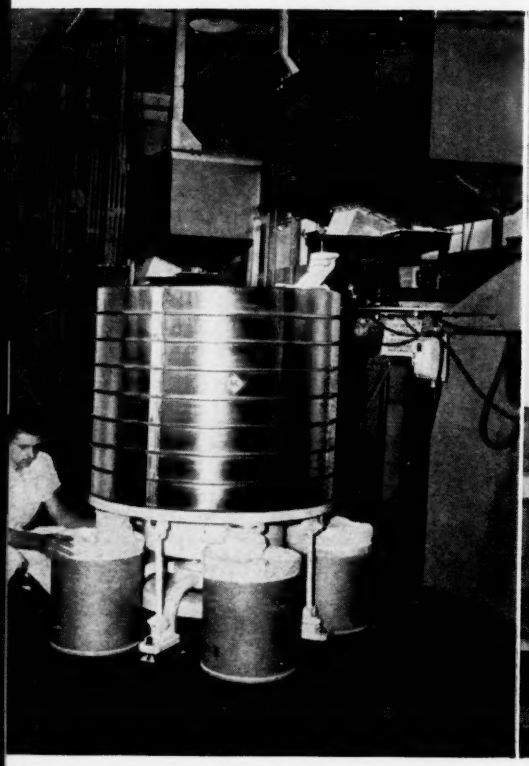
Name_____ Title_____

Company_____

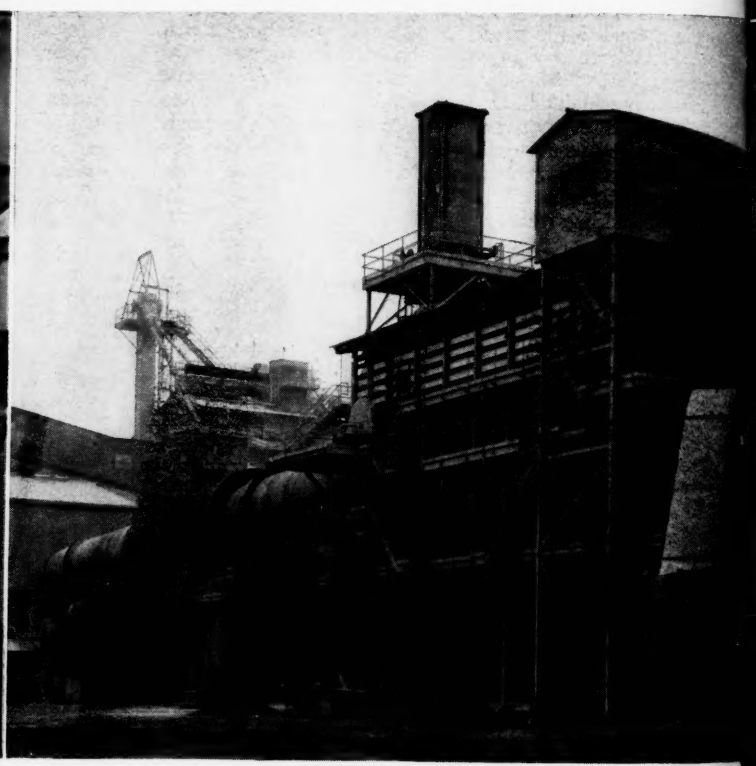
Street_____

City_____ State_____

ideas and news:



Up to 35 square feet of screening area in only 16 square feet of floor space: Stacked-deck design of this gyratory screen conserves valuable space. Cuts maintenance, downtime with all-stainless-steel construction. Abrasive or corrosive materials, dry foods and pharmaceuticals are handled with care. Gentle, quiet, vibrationless operation means minimum disintegration of fragile particles.

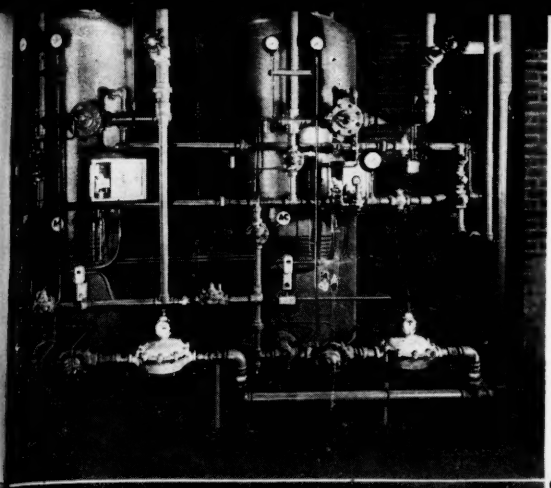


More high quality lime — less fuel: The Grate-Kiln System produces consistent high quality lime using 15% less fuel per ton of product than a conventional rotary kiln. Grate-Kiln Systems increase lime yield from limestone feed—outproduce conventional rotary kilns of the same overall length by 50%. Incorporated is a new high efficiency cooler which transfers maximum recuperated heat to secondary combustion air for kiln and preheater grate.

Which of these productive ideas could be working for you?

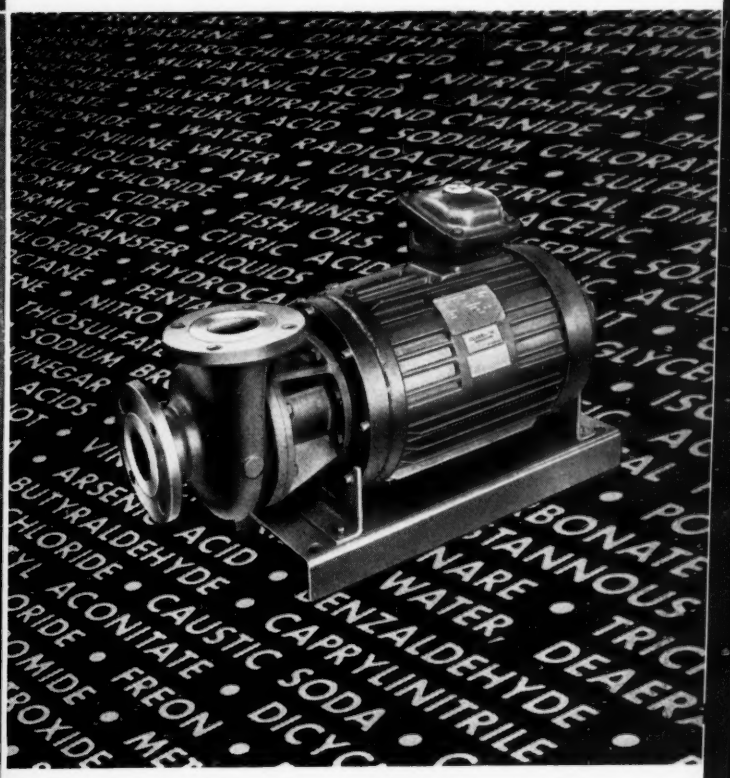
A kiln that uses 15% less fuel per ton of product. A high-voltage control center. A pump that pumps the "unpumpable." These examples demonstrate the extra value that is standard with Allis-Chalmers... the greater efficiency and the added productivity which are yours when you buy A-C products, systems and services. Call your Allis-Chalmers representative for details on A-C "worth-more" features. Or write Allis-Chalmers, Milwaukee 1, Wisconsin.

Grate-Kiln, Electri-Cand, SpaceMaker and Compactor are Allis-Chalmers trademarks. A-1551



Calcium and magnesium are the "vandals" that cause scale in pipes and boilers, clog systems and mean heavy use of cleaning compounds. ZEOLITE is their natural enemy! An A-C zeolite water softener means a simple switch to sodium ions from the usual hardness present in most water supplies. Once A-C conditioned, the "softened" water finds ready use in chemical plants to end scaling problems.

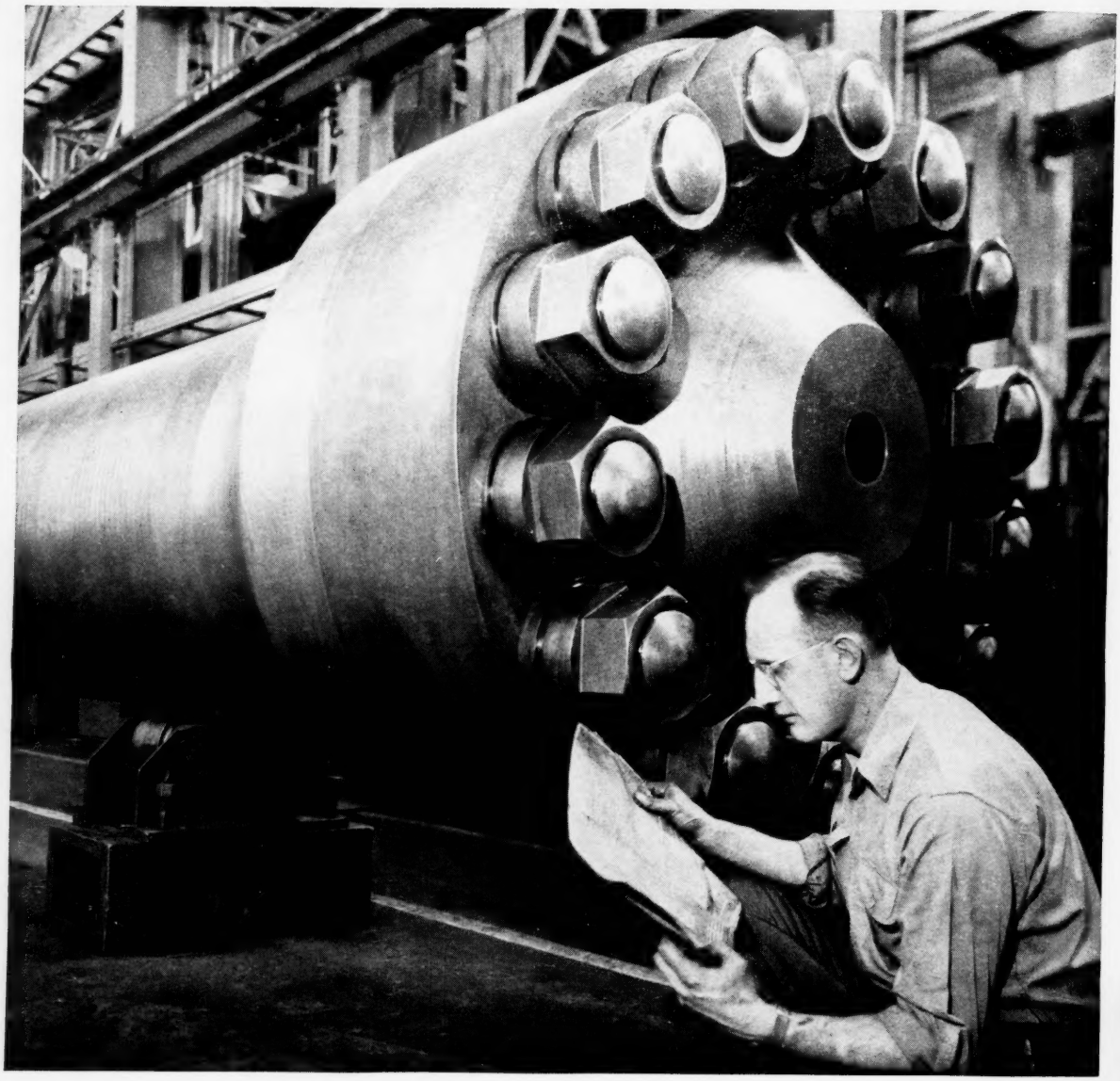
Now pump the "unpumpable": ELECTRI-CAND pumps can handle practically any solids-free fluid with absolute leakproof performance. They save precious liquids, retain volatile and/or toxic fluids, handle corrosives safely. Underwriters-approved for ratings up to 91 psi . . . nearly twice the approved rating of any other "canned" pump.



So low, two fit where one used to go: This new SPACEMAKER control center is the first completely new 2- to 5-kv motor controller development in more than a decade. Two-high design can cut floor space needs in half. Full drawout construction makes it the safest, most easily accessible controller available. Flame-retardent, track-resistant PYRO-SHIELD insulation adds reliability. Walk-in SHELTER-CLAD enclosures available for outdoors.

ALLIS-CHALMERS PRODUCTS FOR THE CHEMICAL INDUSTRY: Look to A-C for atomic, thermal and hydro electrical generating equipment; Compactor mills; compressors; control; coolers; crushers; dryers; earth-moving equipment; engines; grinding mills; industrial systems; kilns; lift trucks; motors; pumps; rectifiers; screens; switchgear; tractors; transformers; unit substations.

ALLIS-CHALMERS



Strong, Seamless Walls 7½ in. Thick

This forged Bethlehem converter, built for use in the making of ammonia, weighs 48 tons. Much of the weight is in the rugged seamless walls, which are solid steel, 7½ in. thick. Those walls are built to contain high pressures, and they will do the job.

Another interesting feature is the circle of huge nuts that hold the vessel's head to the body. Each of them weighs 77 lb and has a diameter of 10 in. There are 14 nuts and matching studs — convincing evidence of the pressures to be handled.

This could be called a typical Bethlehem vessel of medium weight. Our shops are equipped to build both larger and smaller models of autoclaves, reactors, filters, converters, separators, and high-pressure accumulators. Whatever your needs, Bethlehem can meet them—at competitive prices. Deliveries are prompt. Write for details.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Export Sales: Bethlehem Steel Export Corporation

Steel

For strength
. . . economy
. . . versatility

BETHLEHEM STEEL

BETHLEHEM STEEL

VERSATILE

FORMALDEHYDE

FAMILY OF FOUR

STABILIZED FORMALDEHYDE

Penny pincher. When Celanese developed stabilized formaldehyde back in 1959, it marked the beginning of new economies for users of industry's workhorse chemical. It made possible shipment and storage at temperatures 15 to 30°F lower than standard formaldehyde. Now this basic chemical can be transported great distances in insulated tank cars *without reheating*. With consequent cost savings.

Celanese-developed stabilized formaldehyde allows higher concentrations—which means another cost saving for chemical processors. Better end-products, too, because stabilized formaldehyde maintains uniformity longer. Fact is, during the past two years, Celanese stabilized formaldehyde has become famous for its constant assay, freedom from paraformation, and clarity of solution with minimum acid build-up.

FORMCEL SOLUTIONS

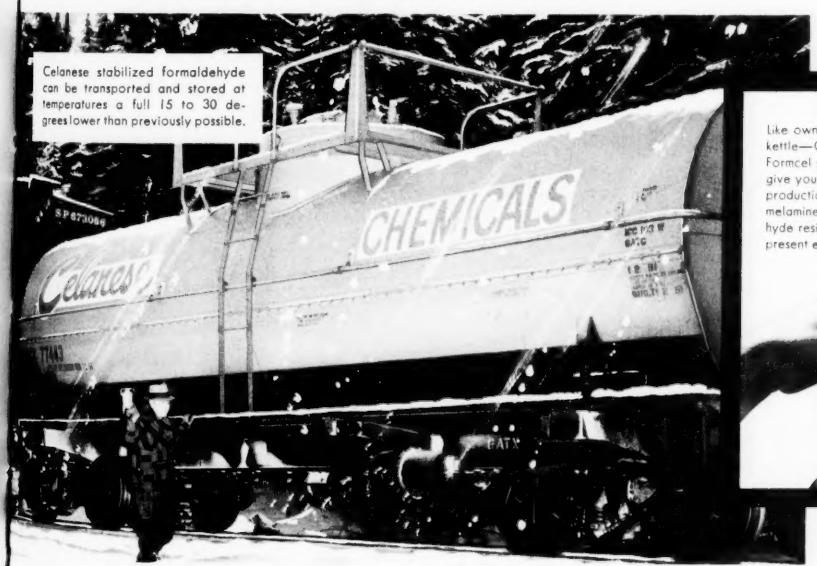
More for your money. When processing involves combinations of formalin and alcohol, there's a practical way to speed production and obtain greater yields. Celanese Formcels—solutions of formaldehyde and alcohols—allow batch sizes so much larger than conventional 37% formalin solutions that it's almost like owning a larger kettle—good news for producers of urea/melamine resins.

PARAFORMALDEHYDE

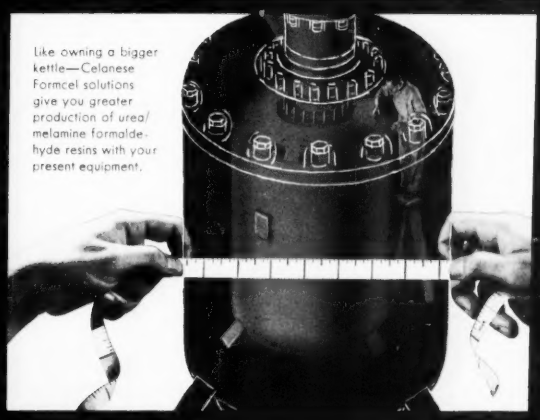
Power of concentration. Celanese paraformaldehyde is a 91% concentration of formaldehyde—available in both flake and powder form. It leads the way to more profitable manufacture of high solids urea and phenolic resins. A low water content is primarily responsible for the larger batches and higher yields you get in shorter cycle and processing time.

TRIOXANE

A name to remember. Celanese trioxane stands alone. It's the only source of anhydrous formaldehyde—which you'll recognize as an intermediate of value in organic synthesis. And trioxane, by itself, is a stable, low-melting solid with strong solvent power. Just one example of its usefulness: Phenol-formaldehyde films formed with trioxane as the solvent are hard in the intermediate stage, before curing—whereas conventional liquid solvents produce a softer film. Yes, trioxane is a chemical you might well investigate.



Celanese stabilized formaldehyde can be transported and stored at temperatures a full 15 to 30 degrees lower than previously possible.



Like owning a bigger kettle—Celanese Formcel solutions give you greater production of urea/melamine formaldehyde resins with your present equipment.

For more information on any or all of the four forms of formaldehyde, mail the coupon on the reverse side of this page.

Celanese
CHEMICALS

LOOKING FOR DIVERSITY IN A DIOL?

Whatever your requirements—polyesters, polyurethanes, surface active agents, polymeric plasticizers, humectants, or coupling agents—there's one diol that's a winner. That's *Celanese 1,3-Butylene Glycol.*

Despite the well-known advantages of 1,3-BG, it just wasn't economically available in commercial quantities—far from true today.

Right now, Celanese has a 25-million pound production capacity for this low cost diol! Fact is, we are the *only* company in the United States with commercial capacity for 1,3-butylene glycol.

Shouldn't you now be using this versatile 4-carbon diol? In addition to its unusual stability, 1,3-BG has a combination of two non-adjacent hydroxyl groups, which minimizes ring closure and dehydration. It's highly hygroscopic, non-toxic, and soluble in water and most organic solvents. Moreover, its longer chain length and molecular configuration open up new possibilities in many fields.

For more specific information about Celanese 1,3-Butylene Glycol, just fill out the coupon and drop it into the mail. Celanese Chemical Company, 522 Fifth Avenue, New York 36, N. Y. Celanese® Formcel®

CELANESE CHEMICAL COMPANY 2-C
522 FIFTH AVENUE, NEW YORK 36, N. Y.

Please rush technical data on the following:

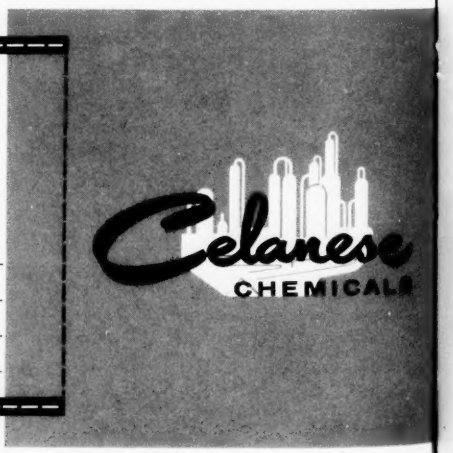
☐ Stabilized Formaldehyde ☐ Formcel Solutions
☐ Paraformaldehyde ☐ Trioxane ☐ 1,3-Butylene Glycol

NAME_____ TITLE_____

COMPANY_____

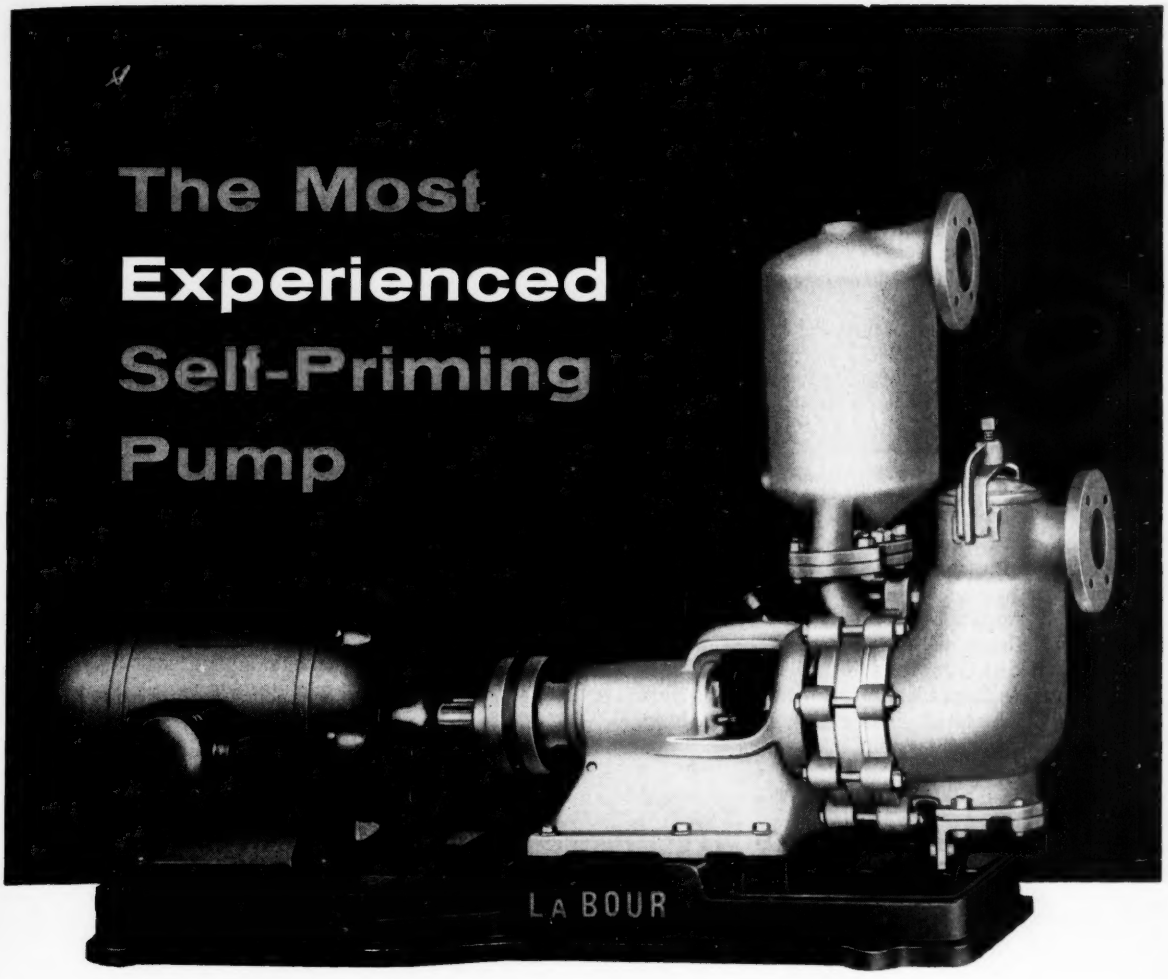
ADDRESS_____

CITY_____ ZONE_____ STATE_____



Celanese Chemical Company is a Division of Celanese Corporation of America
Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 522 Fifth Avenue, New York 36

The Most Experienced Self-Priming Pump



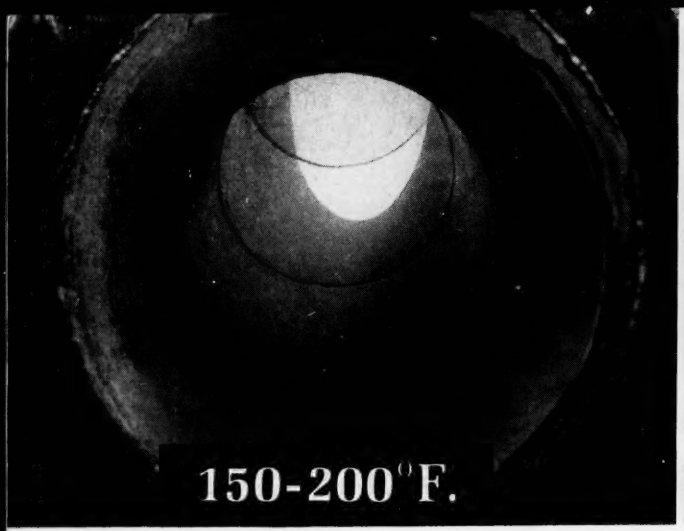
LaBour Type DPL as pictured here is the modern, improved counterpart of the first self-priming pump ever offered to the chemical industry. Nearly 40 years of experience in hundreds of plants all over the world have proved the reliability and efficiency of this unit to the satisfaction of a whole generation of engineers and operating men.

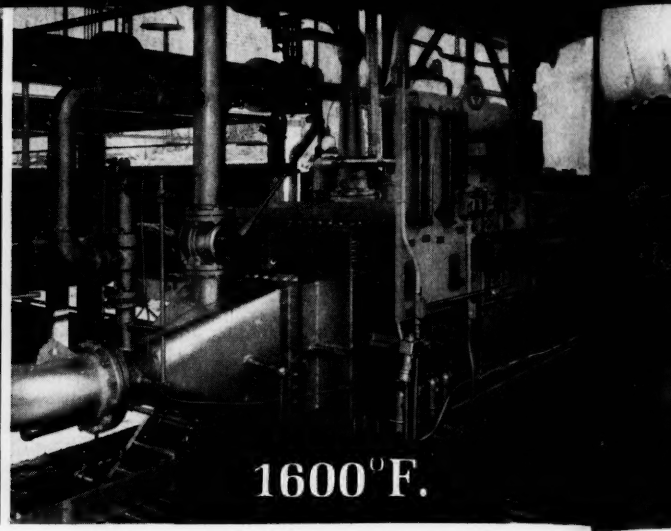
If you're looking for assured performance and dependable, trouble-free economy, you can play safe by specifying LaBour for your toughest jobs as well as for routine applications. Ask us for details.

ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP

LABOUR

THE LaBOUR COMPANY, INC. • ELKHART, INDIANA
WHITE PIGEON, MICH. • LONDON, ENGLAND





REFRACTORY-LINED PIPE RESISTS ABRASIVE BLAST

This silicon-carbide-lined elbow in air conveying system shows no pitting or other wear after 2½ years. Rubber liners previously used were cut through in less than six months by finely divided cement and asbestos particles in the hot air stream. Exceptional wear resistance of Carborundum's silicon carbide refractories makes them ideal for use wherever severe abrasion is encountered, as in dust collectors, blast furnace down-comers, tees and ells in pipe lines.

GAS REFORMER ATTAINS 97% EFFICIENCY WITH ALUMINUM OXIDE CHECKERS

Fluted ALFRAX® Al_2O_3 checkers are laid face to face forming small parallel flues in the gas reformer unit. High specific heat and density of the fused aluminum oxide checkers provide an ideal heat-storage mass. Their chemical stability and purity prevent destructive reactions. Typical gases reformed are propane, butane and natural gas at maximum gas temperatures of about 1600°F. Conversion efficiency is 97%.

SKID RA TONNAGE

After one rails still 16,500 to ing a shu as 1/16". Co ice obtai replacem turn, cut type furn

Report from Carborundum:

How specialized refractories excel in

HEATING CYCLE IS CUT BY ONE-THIRD

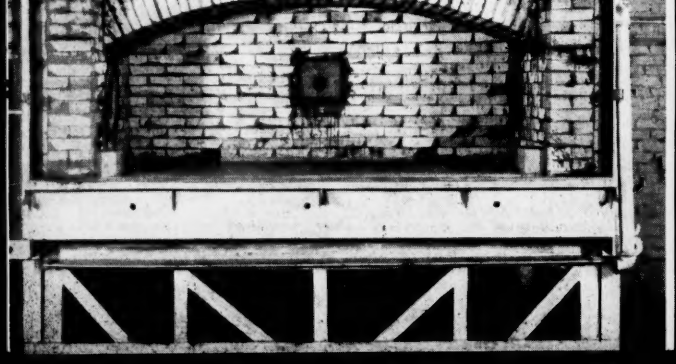
By changing from a firebrick lining to ALFRAX® BI "bubble brick," heating cycle of this slot-type forge furnace dropped from 45 minutes to 30 minutes. This refractory offers high temperature resistance, thermal insulation and load-carrying ability. It is installed in the front, side, and back walls and arch. Silicon carbide brick are used in the floor. Furnace is oil-fired, operates five days a week without shutdown. Materials give 12-18 months service.

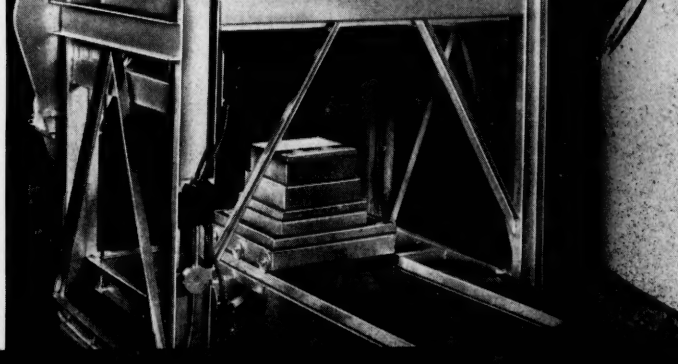
REFRACTORY TILE TAKES HEAT SHOCK

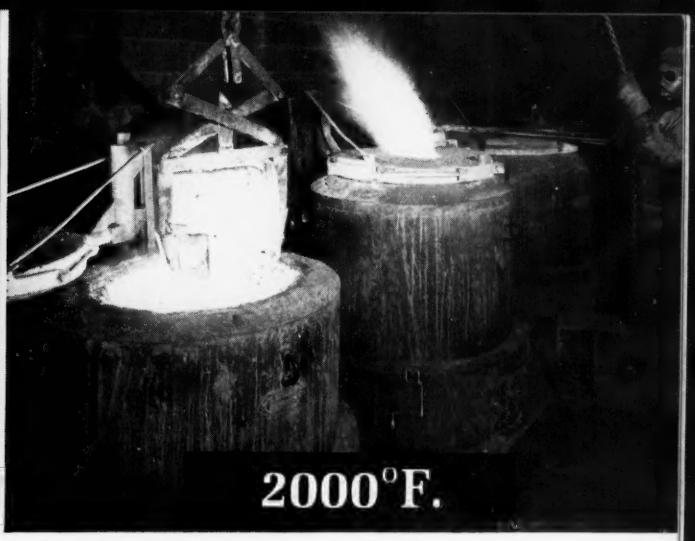
Powdered metal parts are raised into this sintering furnace on an "elevator." The parts are placed on a CARBOFRAX® tile on top of the lift. The tile fills the need for high resistance to thermal shock and provides a hard, dense surface. Chamber is lined with ALFRAX® BI aluminum oxide brick, used for low heat capacity, high refractoriness and good thermal insulating value.

THIN-WA

This furn cracked a ribbon w then coat walls, po aluminum curate an piled arou







SKID RAILS CARRY TONNAGE LOADS WITH MINIMUM WEAR

After one year, these CARBOFRAX® silicon carbide skid rails still looked good as new, though they had carried 16,500 tons of forging billets. Four months later during a shutdown period the total wear was measured as 1/16". Compare this record with the two-weeks service obtained from a rammed chrome hearth. Each replacement required furnace shutdown which, in turn, cut output. Temperature rise through pusher-type furnace is 1400°F.

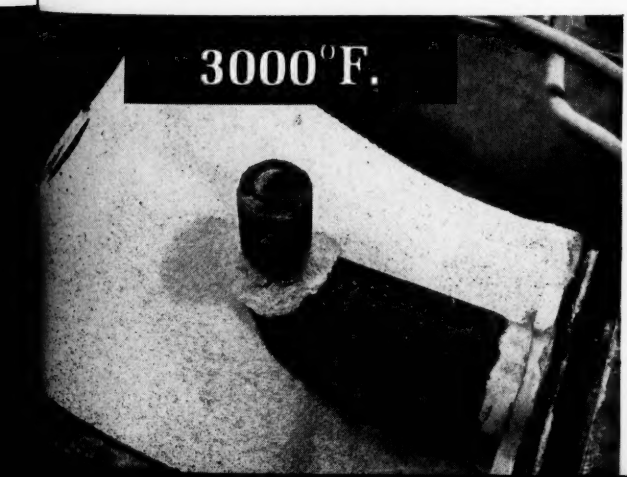
CRUCIBLE LINING FOR Al-Cu ALLOYS HAS LONG LIFE

Each of these crucible furnaces is equipped with a CARBOFRAX® block-type lining. The individual silicon carbide shapes are tongue-and-grooved for strength and stability and are easily installed. Long life of the blocks eliminates frequent patching and permits steady, reliable operation. Clinkers do not form, so that heat radiates uniformly from linings to crucible. The coke-fired furnaces are used to melt high-quality aluminum bronze.

el in low to high temperature jobs

THIN-WALLED MUFFLE IS RUGGED, STABLE

This furnace operates up to 3000°F in a hydrogen or cracked ammonia atmosphere. Heat source is a moly ribbon wrapped around an ALFRAX® PK muffle and then coated with insulating cement. Even with its thin walls, power requirements are not excessive. The aluminum oxide muffle is rugged, dimensionally accurate and has long life. Fused alumina "bubbles" piled around muffle are used to insulate the furnace.



Want help on your problems?

Carborundum engineers will be glad to recommend refractories to answer your specific needs. For information, contact Dept. H-101, Refractories Division, The Carborundum Co., Perth Amboy, N. J. Descriptive brochures available on request. Please specify the area or areas of particular interest to you.

for engineered refractories... count on

CARBORUNDUM®

IT'S A SWIRL WORLD

By applying the basically simple technique of swirling liquids and liquid/solid mixtures at extremely high speeds, Sharples Centrifugal Systems are able to effect accurate, continuous and controlled separation required in the manufacture of products ranging from penicillin to blood plasma . . . from face powder to solid fuel . . . from diesel oil to salad oil . . . from rare earths to everyday plastics . . . from powdered metals to fertilizer pellets . . . from instant coffee to sugar.

An excellent example of the versatility of Sharples centrifuges can be seen in the *Super-D-Canter*. This high-speed centrifuge will continuously recover crystalline solids from slurries . . . remove amorphous solids from suspensions . . . classify solids and clarify liquids. It handles slurries with solids content of from ½% to 50% and solid particles from ¼ inch to a few microns in size . . . *without adjustment!*

As the manufacturer of the world's most complete line of centrifuges, Sharples offers unbiased recommendations backed by broad industrial experience. It's a *Swirl World* whenever you think of centrifuge equipment, systems, plants for industrial processing. The Sharples Corporation, 2300 Westmoreland Street, Philadelphia 40, Pa.

SHARPLES

Representatives
and associated companies throughout the world

2 WAYS TO ATTACK FLOOR PROBLEMS

THIOKOL LIQUID POLYMER-BASE MORTARS with epoxies are meeting industry's most serious flooring problems.

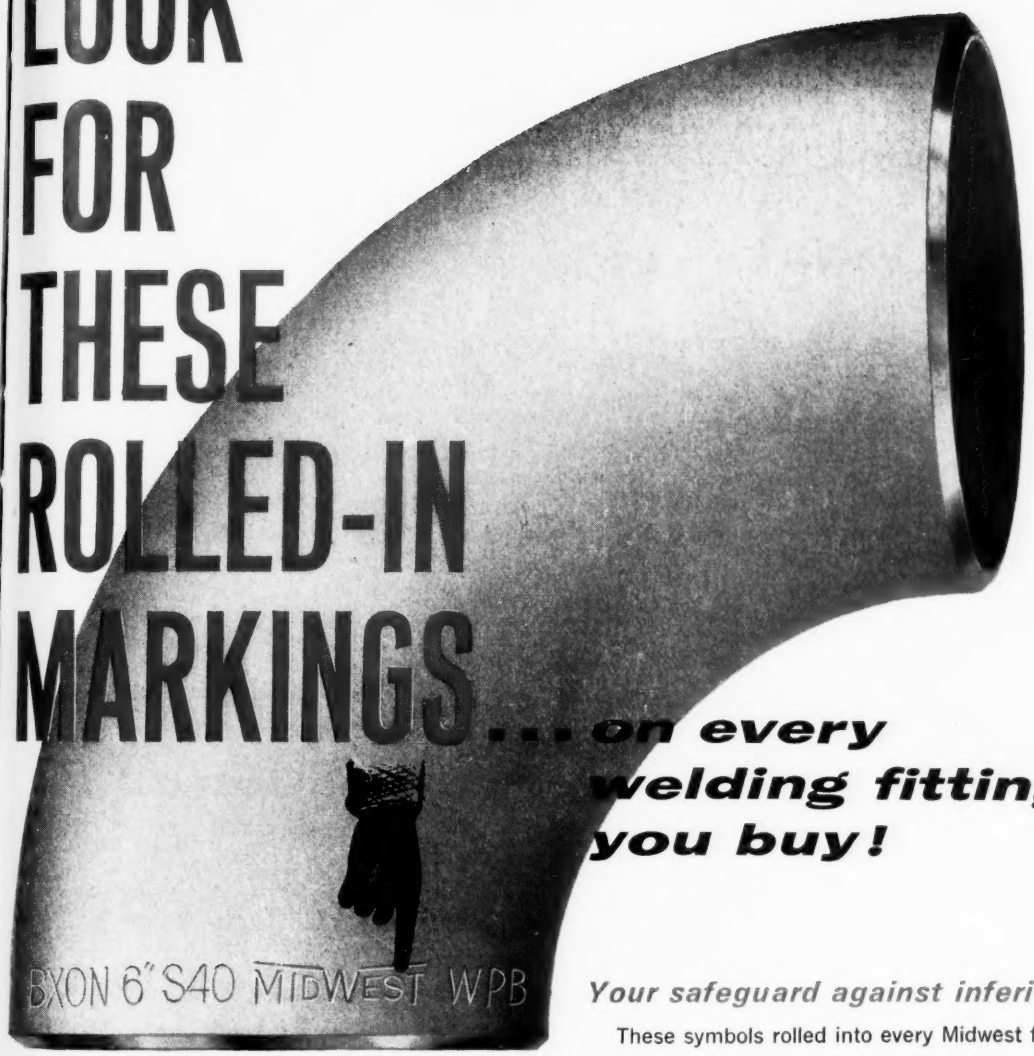
IN PLANTS GOING UP—where the manufacturing process is recognized as potentially destructive to conventional materials—liquid polymer-base mortars can be installed originally to avoid frequent, costly maintenance.

IN EXISTING PLANTS—faced heretofore with a continuing cycle of restoration—liquid polymer base mortars have been used for remedial application. These compounds have ended, once and for all, profit-robbing down time, hazards to personnel, unsightliness, and high maintenance outlays.

THIOKOL liquid polymer-base mortar stands up to heavy traffic, abrasion, chemical attack like no other flooring compound. It can be applied over existing surfaces regardless of their composition, and is ready for traffic in less than a day. For complete data, send for Brochure FC-100.

Thiokol®
CHEMICAL CORPORATION
780 N. Clinton Ave., Trenton 7, N. J.
In Canada: Naugatuck Chemicals Division, Dominion Rubber Company, Elmira, Ontario

LOOK FOR THESE ROLLED-IN MARKINGS...



...on every welding fitting you buy!

BXON—HEAT SYMBOL—Used to identify physical properties, chemical analysis of raw material, radiographic control testing, and heat treatment.

6" S40—SIZE AND WALL THICKNESS

MIDWEST —TRADE MARK—Your Midwest distributor's guarantee of brand-new fittings made from prime domestic steel.

WPB GRADE OF STEEL—Your identification of the grade of steel... and your assurance that each Midwest fitting is made in full compliance with ASTM and ASA standards.

Your safeguard against inferior quality

These symbols rolled into every Midwest fitting are your guarantee of brand-new fittings made from prime domestic steel in full compliance with ASTM and ASA standards!

Even the markings are made with specially designed low-stress dies to preclude injury to the steel. Care such as this demonstrates Midwest's sincere determination to manufacture fittings of highest quality throughout... unmatched anywhere!

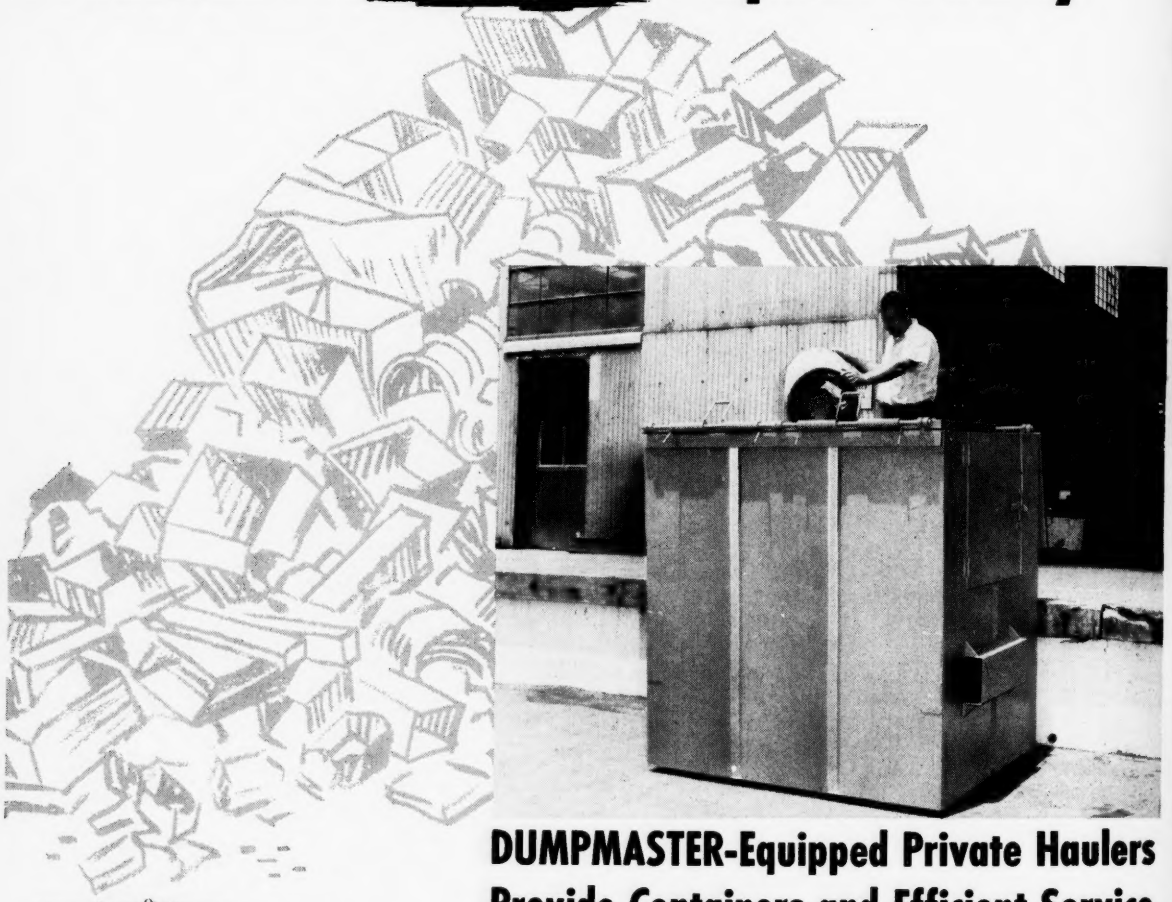
Write for Bulletin 60C, ONLY MIDWEST MAKES BOTH, the story of how superior quality fittings are made from either seamless tubing or rolled plate.

MIDWEST PIPING

A Division of Crane Co. / 1450 South Second St., St. Louis 4, Mo.

6124

NOW! You Can End Refuse Storage Problems...WITHOUT Capital Outlay



IN ALL LEADING CITIES
FROM COAST TO COAST

DEMPSTER DUMPMASTER®
Equipped Private Haulers

DUMPMASTER-Equipped Private Haulers Provide Containers and Efficient Service

If you're plagued with trash piles, scattered refuse, fire hazards, and hit-or-miss collection, there's a good chance you can do something about it . . . WITHOUT CAPITAL OUTLAY!

In most major cities DEMPSTER-DUMPMASTER-equipped private haulers will put clean, big-capacity storage containers at convenient locations in your plant . . . empty them mechanically on schedule, or on a call-in basis . . . all for a reasonable monthly fee.

When you containerize your refuse, plant housekeeping becomes easy, employee morale goes up.

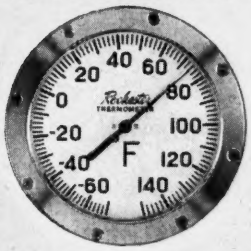
Write today for the name of your nearest private hauler. We'll also send literature describing his service.

Write Today for
Free Brochure and Name of Nearest Private Hauler
DEMPSTER BROTHERS
Inc.
Dept. CE-10 KNOXVILLE 17, TENNESSEE

BASIC in the Processing Industry

Process engineers searching for components to act as nerve centers for their products are sure to find the value of these American-Standard Controls Division products. This is true of anybody who must control or indicate the pressure or temperature of gases and fluids or electrical energy.

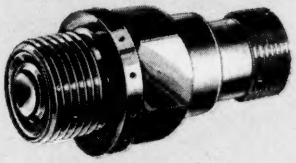
Industrial Thermometers



Rochester bimetal industrial dial thermometers provide extreme accuracy, are hermetically sealed and can be externally calibrated. Available in standard dial sizes from 1″ to 5″, and with scale ranges from minus 150°F to 1000°F.

AMERICAN-Standard
CONTROLS DIVISION

Norwood Transducers

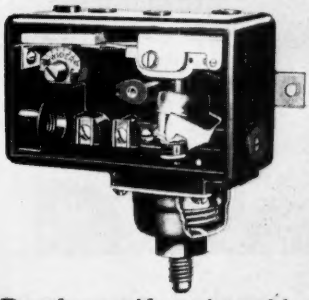


Norwood bonded strain gage pressure transducers can be used wherever precision measurement of static and dynamic pressures are vital. They are virtually unaffected by extreme vibration or acceleration through the entire pressure range 0 to 60,000 psi. Models are available uncooled or for either air or water cooling. With air cooling gas temperatures as high as 2000°F can be safely applied. Water cooled models can measure gas pressures at temperatures to 5000°F; liquids to 1000°F.

AMERICAN-Standard
CONTROLS DIVISION

You can get detailed information on any of these products by writing American-Standard Controls Division, 5900 Trumbull, Detroit 8, Michigan.

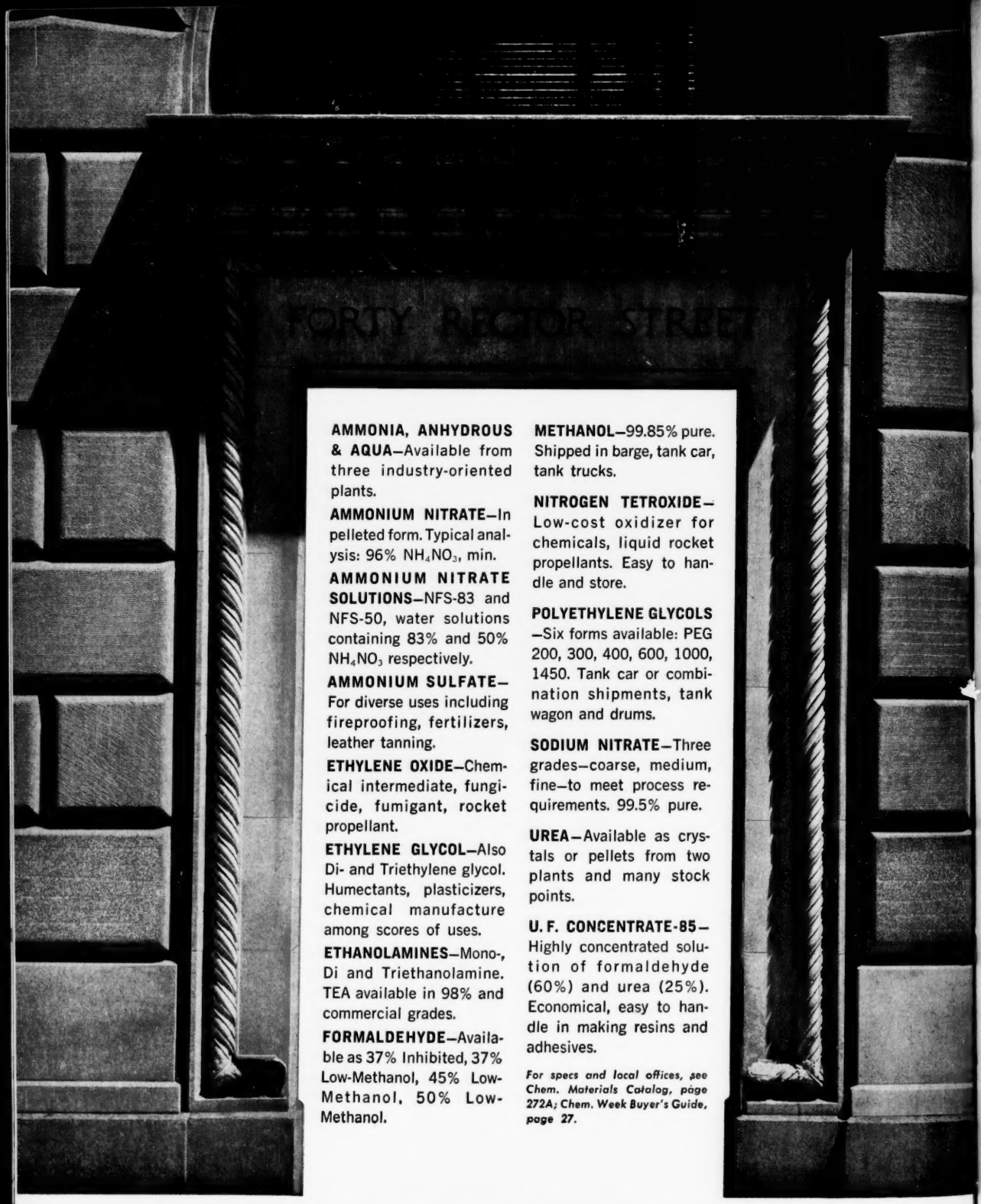
Pressure, Temperature Controls



ASCD makes a wide variety of heavy duty controls for either pressure or temperature applications. They are extraordinarily rugged, can be designed to meet almost any condition.

AMERICAN-Standard
CONTROLS DIVISION

AMERICAN-Standard
CONTROLS DIVISION



AMMONIA, ANHYDROUS & AQUA—Available from three industry-oriented plants.

AMMONIUM NITRATE—In pelleted form. Typical analysis: 96% NH_4NO_3, min.

AMMONIUM NITRATE SOLUTIONS—NFS-83 and NFS-50, water solutions containing 83% and 50% NH_4NO_3 respectively.

AMMONIUM SULFATE—For diverse uses including fireproofing, fertilizers, leather tanning.

ETHYLENE OXIDE—Chemical intermediate, fungicide, fumigant, rocket propellant.

ETHYLENE GLYCOL—Also Di- and Triethylene glycol. Humectants, plasticizers, chemical manufacture among scores of uses.

ETHANOLAMINES—Mono-, Di and Triethanolamine. TEA available in 98% and commercial grades.

FORMALDEHYDE—Available as 37% Inhibited, 37% Low-Methanol, 45% Low-Methanol, 50% Low-Methanol.

METHANOL—99.85% pure. Shipped in barge, tank car, tank trucks.

NITROGEN TETROXIDE—Low-cost oxidizer for chemicals, liquid rocket propellants. Easy to handle and store.

POLYETHYLENE GLYCOLS—Six forms available: PEG 200, 300, 400, 600, 1000, 1450. Tank car or combination shipments, tank wagon and drums.

SODIUM NITRATE—Three grades—coarse, medium, fine—to meet process requirements. 99.5% pure.

UREA—Available as crystals or pellets from two plants and many stock points.

U. F. CONCENTRATE-85—Highly concentrated solution of formaldehyde (60%) and urea (25%). Economical, easy to handle in making resins and adhesives.

For specs and local offices, see Chem. Materials Catalog, page 272A; Chem. Week Buyer's Guide, page 27.

under one roof...your best source for basic chemicals

Allied Chemical

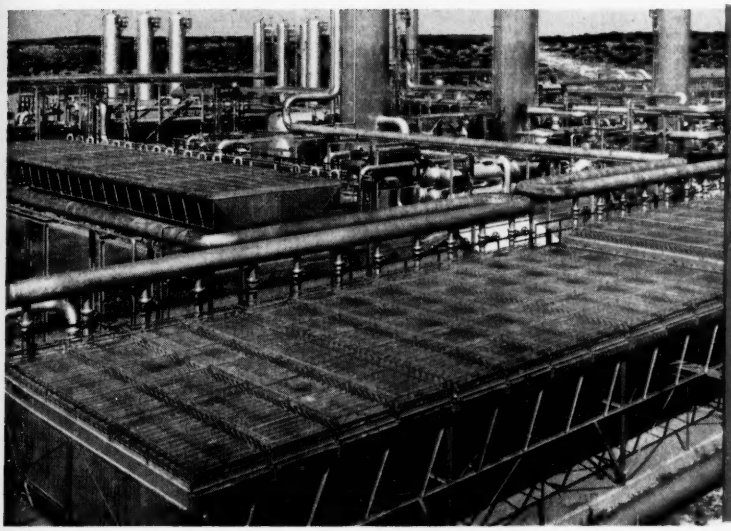
BASIC TO AMERICA'S PROGRESS

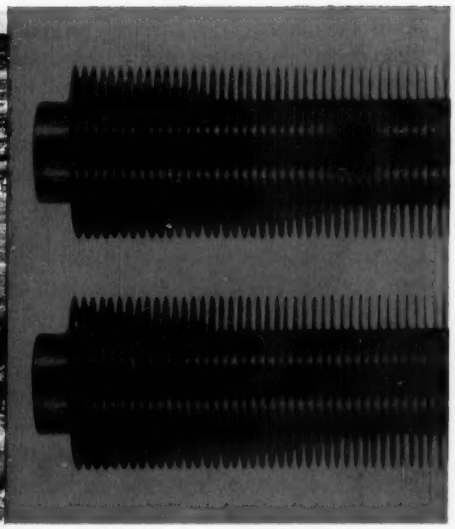
NITROGEN DIVISION

Dept. AP12-5-3, 40 Rector Street, New York 6, N. Y.

2819

IT'S CHEAPER TO KILL HEAT WITH AIR





COMPARE TRANSAIRE . . . no matter what your water situation. Transaire air-cooled heat exchangers already have found wide acceptance in areas where water cooling is impractical or impossible. And now, finding that Transaire is less expensive to operate, even where water is plentiful, other areas are turning to this economical unit.

Simple in basic design, Transaire units are being used in many varied operations where low maintenance and low operating costs are important over extended periods of time. The high heat transfer efficiency is attained by use of the Yuba fintube. Its exclusive design employs tapered spiral fins mechanically bonded so that the entire base tube is covered and protected against the galvanic action that destroys efficiency in many other types of fintube. Both fins and base tubing can be provided in almost any material, size or gauge desired. Fin spacing and height can be varied to requirements. It's cheaper to kill heat with air – next time compare Transaire, a product of Yuba, pioneers in air-cooled heat exchangers.

Yuba also manufactures a complete line of shell and tube heat exchangers, and will recommend either type, whichever is required or best suited for the job.

YUBA

specialists in heat transfer equipment

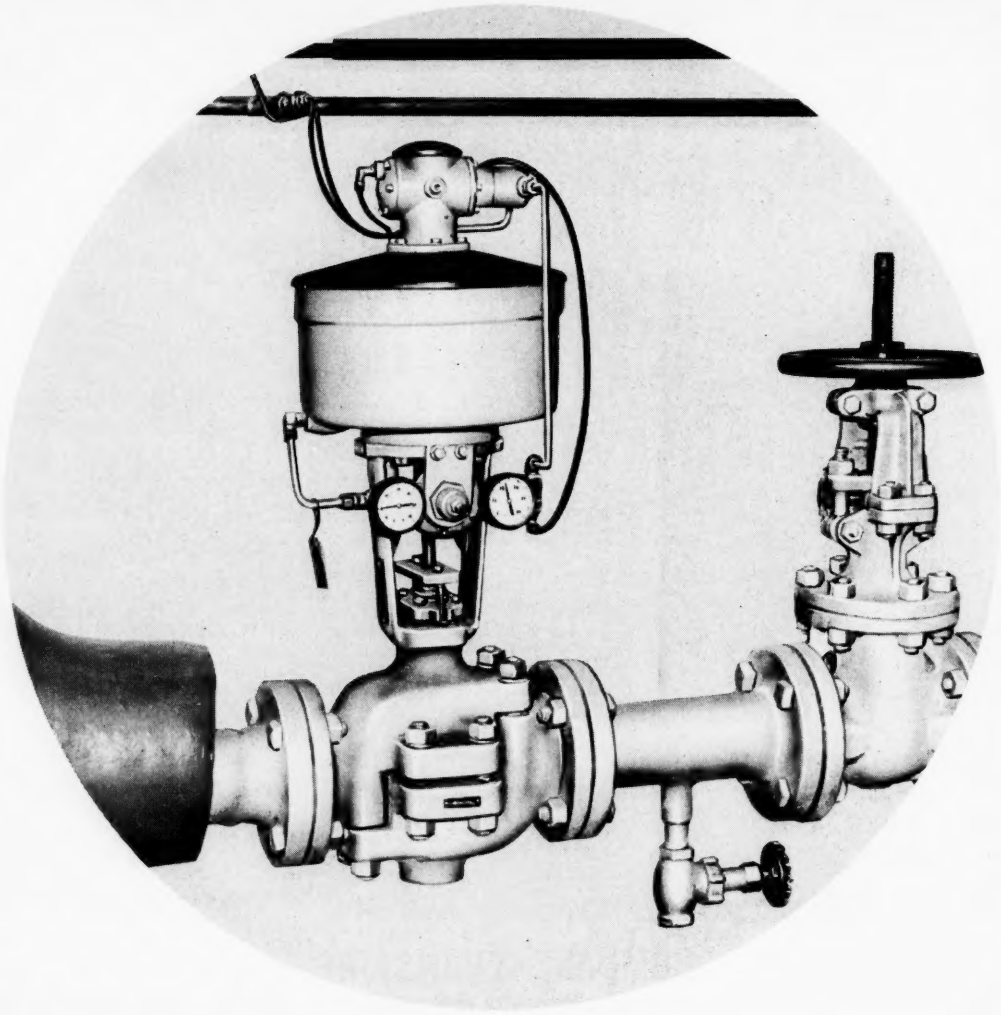
YUBA HEAT TRANSFER CORPORATION

Tulsa, Oklahoma

YUBA CONSOLIDATED INDUSTRIES, INC.

Sales Offices in Chicago • Houston • Los Angeles • New York • Pittsburgh • San Francisco

INTERNATIONAL LICENSEE: Birwelco Ltd., Birmingham, England (United Kingdom, British Commonwealth).



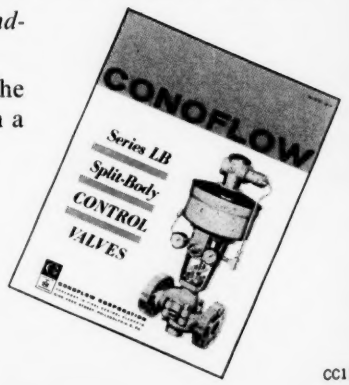
A Split-body Valve is not a "Specialty"

...it is a practical, all-purpose control valve

The Conoflow Series LB valve shown is handling 100 psi steam. This is not unusual. Actually, the vast majority of the thousands of LB valves in service are handling water, steam and other common plant fluids. In fact, more than 80% of LB orders call for *standard* cast steel or ductile iron construction.

LB valves were selected because they give *better control, greater dependability* and *unequalled maintenance savings,* all at a *low initial cost.*

More and more users are standardizing on the LB valve right down the line because they know that LB valves mean *less downtime,* resulting in a more profitable plant operation.



Write for NEW Bulletin LB-4. Be convinced.

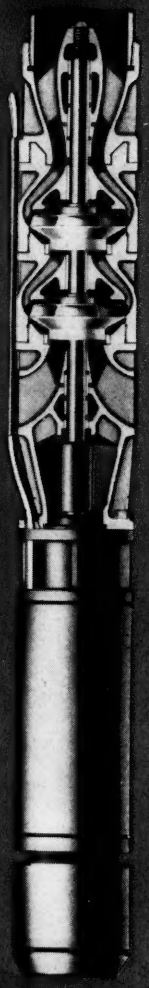
CONOFLOW SUBSIDIARY WALWORTH

CONOFLOW CORPORATION

FOREMOST IN FINAL CONTROL ELEMENTS

2100 ARCH STREET, PHILADELPHIA 3, PA.

CC110



Regular Submersible

Layne SINCE 1882

SUBMERSIBLE PUMPS

deliver water

economically

consistently

silently

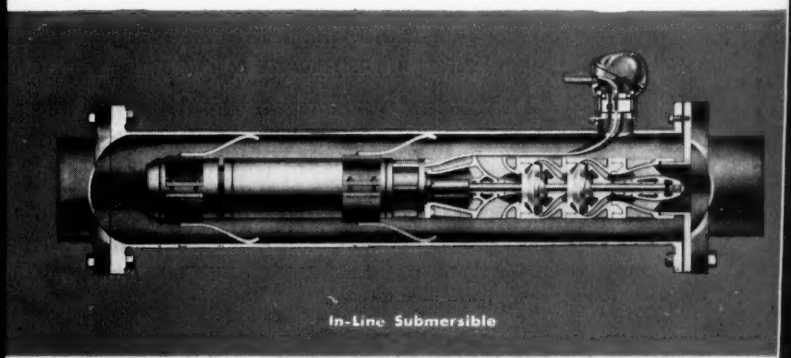
efficiently

The Layne Submersible Pump installation gives you noise free operation because the pump and motor are completely submerged. The Layne Submersible is adaptable to all wells; requires a minimum of space since no pump house is required; eliminates possibility of water contamination; and eliminates the opportunity for vandalism or other accidental mishap or damage.

Layne Submersible Pumps are available for wells as small as 6 inches and in capacities from 30 GPM up. For additional information write for free bulletin number 202.

The Layne In-Line Submersible pump provides the answer to many problems in booster pump applications. The pump operates as an integral part of the line and is designed for use by municipalities, industry, such as petroleum and chemical plants and by agriculture. Advantages include: simple installation, no additional space required, continuous service even under flood conditions, and no possibility of surface water contamination.

Layne In-Line pumps are made as small as 4 inch bowls on a 4 inch motor for use in a 6 inch pipe to deliver 30 GPM. Larger sizes are available as required. For additional information write for free bulletin number 203.



In-Line Submersible

Layne SINCE 1882 — COMPLETE WATER SERVICE

LAYNE & BOWLER, INC., MEMPHIS

General Offices and Factory, Memphis 8, Tenn.

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

Sales Representatives in Major Cities

Find LAYNE Fast in the Yellow Pages under pumps

This Helium Transport, built by The Taylor-Wharton Division of Harsco Corporation for General Dynamics Corporation can deliver 114,000 standard cubic feet of Helium at a pressure exceeding 2,400 p.s.i. from Amarillo, Texas to Los Angeles, California; a distance of 2,166 miles round trip.

As in many other cases, this transport has provided more efficiency and economy in operations than would have been found in any other means of transportation.

For their semi-permanent storage as well as for transporting compressed gases, many gas producing, oil refining, petro-chemical, food and electronic companies now employ flexible, mobile gas transports.

Why don't you? Write to:

HARRISBURG STEEL CO.
Division of HARSCO CORPORATION
HARRISBURG 26, PENNSYLVANIA

ENGINEERING

NEWS YOU CAN USE ABOUT ENGINE AND COMPRESSOR PERFORMANCE

Why these packing rings are hermetically sealed

No doubt about it, these Cook packing rings have received very special treatment.

Immediately after manufacture, they were carefully inspected, oiled, then hermetically sealed in a plastic bag to protect against dirt, moisture, and damaging corrosive atmospheres. You can be sure that the quality and precision of these Cook rings will not deteriorate before they're put into service.

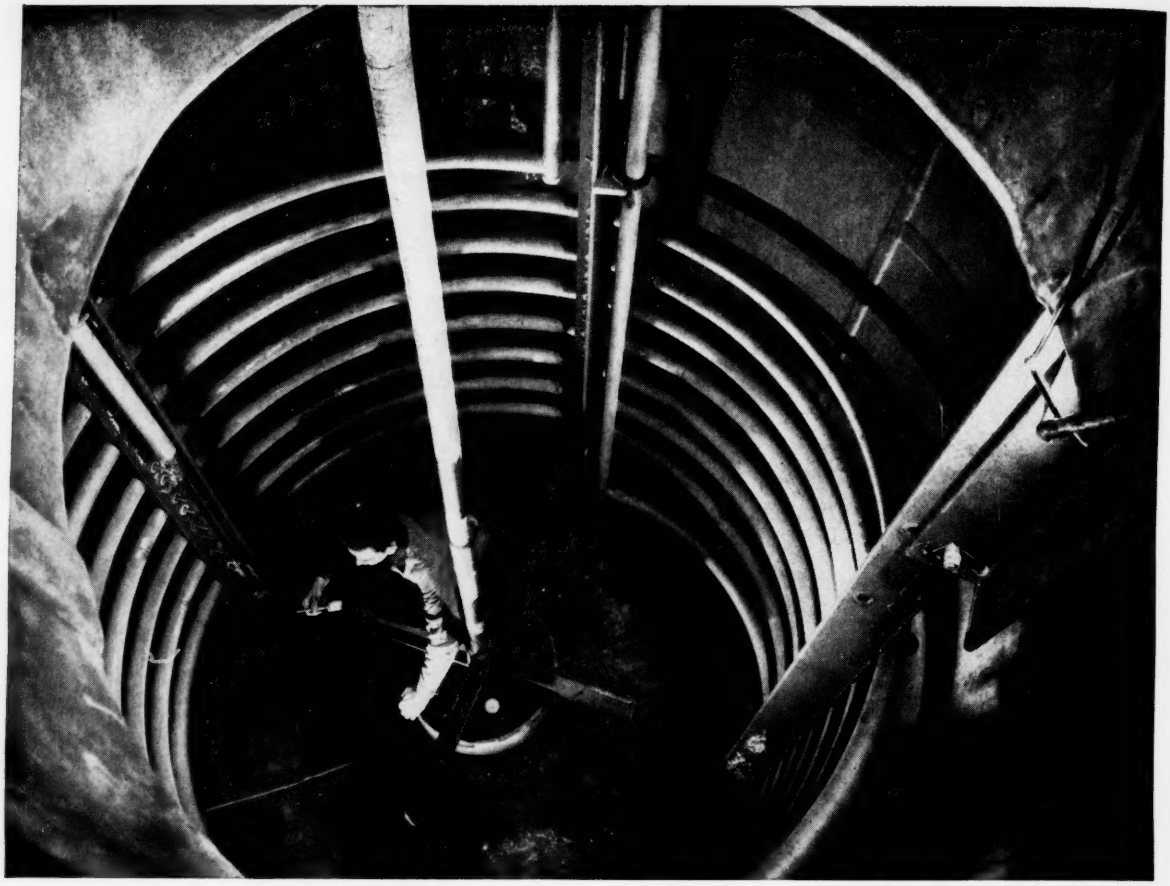
This "red carpet" handling of a very important item is but another example of Cook's attention to detail — resulting in continued superiority of the finished product.

Cook packing rings are precision made to always give you a perfect seal — no matter how difficult the special sealing requirements of your application. Ask a C. Lee Cook representative for complete information. Or, write C. Lee Cook Division, Dover Corporation, 958 South 8th Street, Louisville, Kentucky.

C. LEE COOK

DIVISION OF DOVER CORPORATION

Rings and Packings Since 1888



This titanium coil has eliminated downtime due to corrosion and erosion. Result...

In hypochlorites...

Lifetime Titanium heat exchanger pays for itself with trouble-free performance at Pennsalt

Titanium's ability to withstand hot chlorine environment, its noncontaminating and antifouling characteristics have put a stop to costly trouble before it started in Pennsalt's calcium hypochlorite process.

Two titanium heat exchanger coils are located in the heart of the operation:

Chlorinator. Chilled water pumped through the titanium coil carries off heat evolved when lime slurry is chlorinated. Coil has been completely trouble-free, despite *hot,* wet chlorine environment. No need for repairs. And the chemical buildup on the coil is easily washed off with water.

Pennsalt engineers say that the titanium coil, placed in service in 1959, still shows no sign of corrosion nor erosion. Because of this, the unit has at least paid for itself from reduced downtime.

Crystallizer tank. Still in place after three trouble-free years, the titanium coil has far outperformed a vinyl-coated stainless steel coil that lasted for only one year.

Titanium costs are dropping. For example . . . the latter titanium coil originally cost $6,200. As an experiment, Pennsalt engineers had the unit re-estimated recently. They found that they could purchase a new coil—including an additional $850-worth of spacers—for a total of $4,204!

Lesson to be learned: Selection of the *right* titanium fabricator (TMCA can help you with this) is a sure-fire way of controlling your costs. Also, basic metal prices are improving. In the past three years they have been reduced by 50%.

If you are faced with maintenance problems in equipment operating in wet chlorine . . . or hypochlorites . . . or urea . . . or inhibited sulfuric acid, contact TMCA. Our chemical experience is at your disposal.

Get the facts:
Performance data . . . fabrication.
Write Today.

TIMET®

TITANIUM METALS CORPORATION OF AMERICA

233 Broadway, New York 7, N.Y.

NEW YORK • CLEVELAND • CHICAGO • DALLAS • LOS ANGELES

ALEMITE BARREL-TO-BEARING LUBRICATION...

prime mover in production!

Plant men who recognize lubrication as an important production tool – not just a maintenance problem – are collecting new dividends in increased production.

They use modern Alemite Barrel-to-Bearing Lubrication . . . years ahead methods that add efficiency and speed up production in all sizes and types of plant operations . . . assure better, lower-cost protection . . . cut downtime, prolong machinery life.

Alemite lubrication equipment includes electric, air or hand-operated equipment . . . everything required for high-pressure lubrication, filling of hydraulic systems, servicing oil reservoirs, lubricating gear housings, and refilling grease guns.

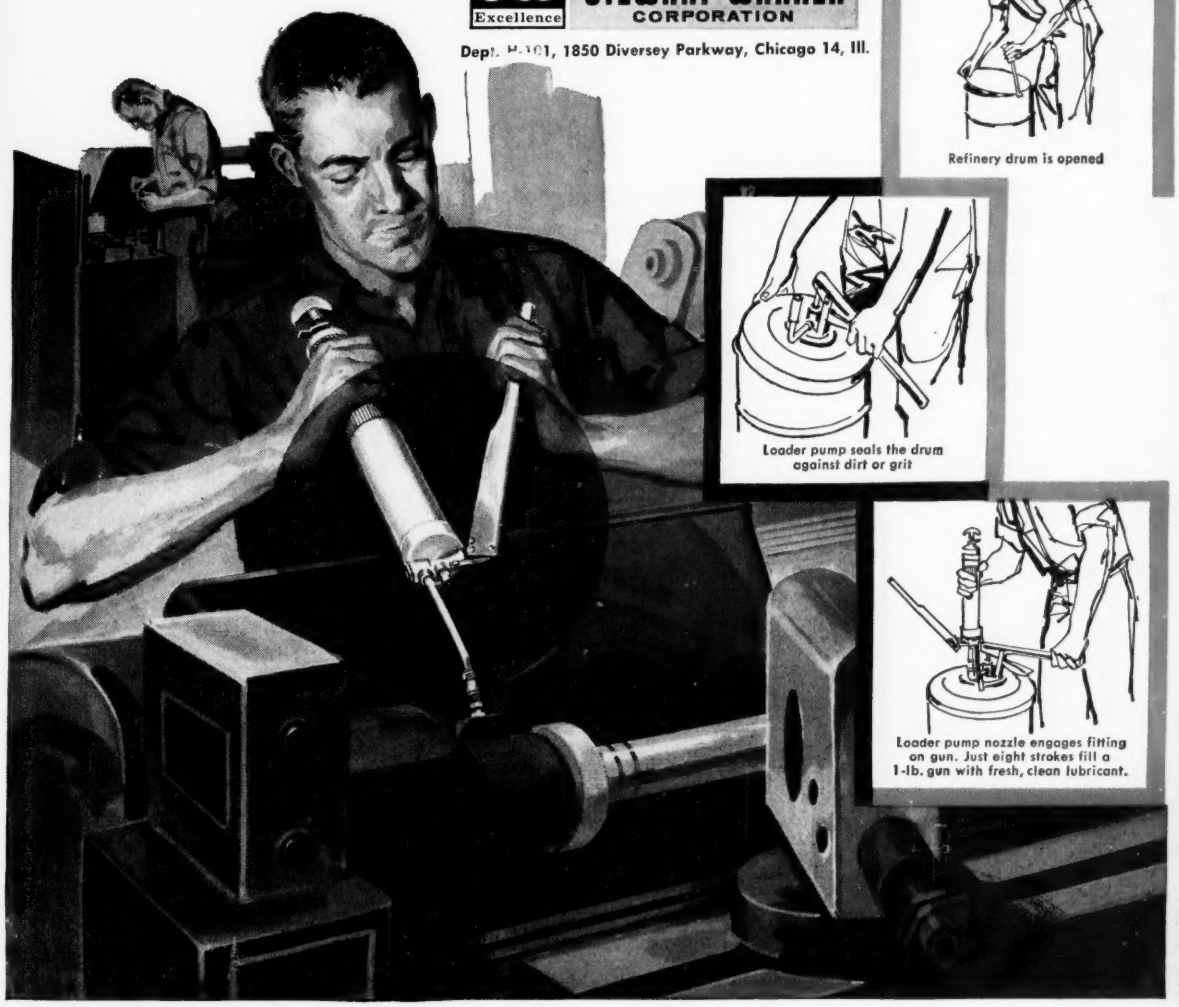
Let an Alemite expert help you with the most efficient lubrication system ever developed. A letter or phone call will bring him to you, at no cost or obligation.

Write for free Alemite catalog today!

Symbol of SW Excellence

ALEMITE DIVISION
STEWART-WARNER CORPORATION

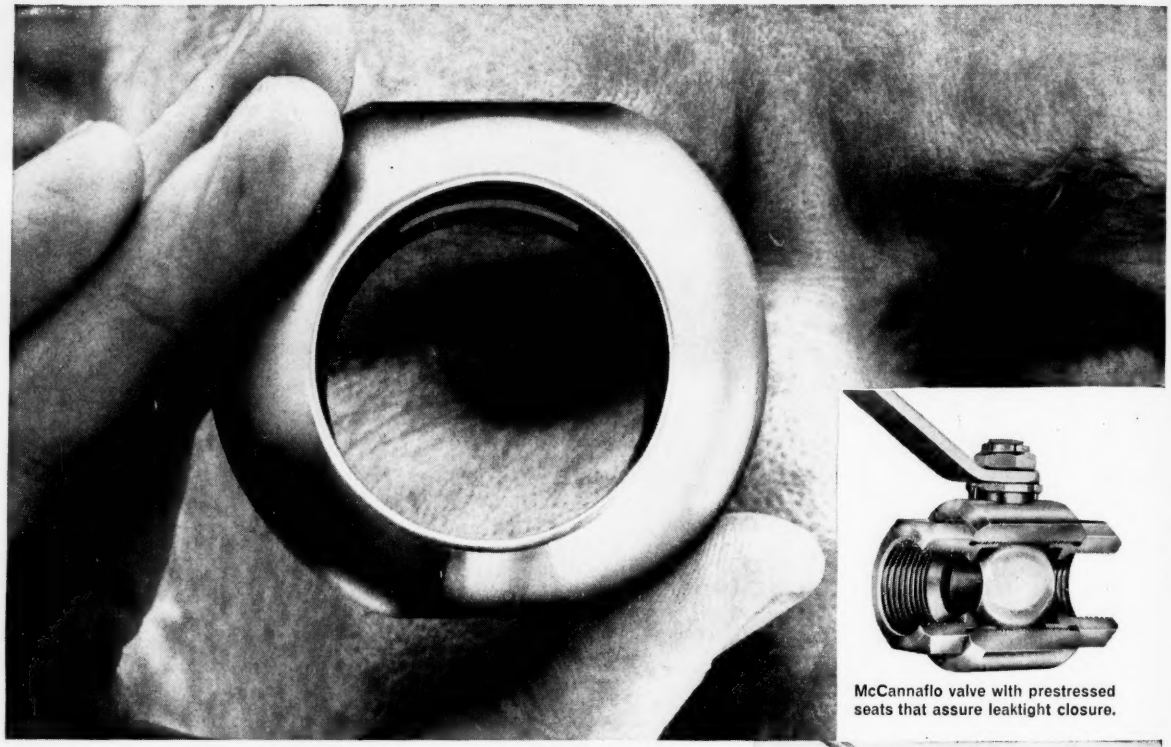
Dept. H-101, 1850 Diversey Parkway, Chicago 14, Ill.



Refinery drum is opened

Loader pump seals the drum against dirt or grit

Loader pump nozzle engages fitting on gun. Just eight strokes fill a 1-lb. gun with fresh, clean lubricant.



McCannaflo valve with prestressed seats that assure leaktight closure.

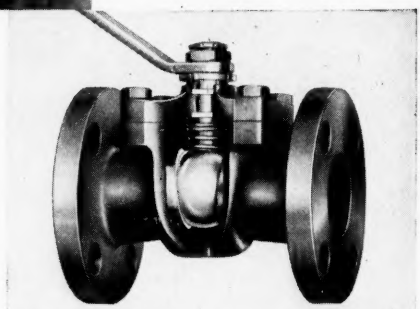
You can see the sense to HILLS-McCANNA Ball Valve Design

the only ball valves available for service to 1000° F

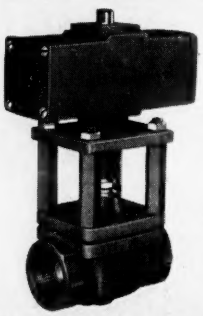
In addition to the basic ball valve advantages—exceptional wear life, negligible pressure drop, quarter-turn open and close, self-cleaning operation, and leaktight closure—Hills-McCanna offers:

- Graphitar® seats for temperatures to 1000° F
- "Fire-Seal"® seats for positive closure in event of fire
- Standard seats of Buna-N, Neoprene, Teflon, and reinforced Teflon for temperature ranges from —150° F to 600° F
- Valves for pressures from 10^{-6} mm Hg to 1000 psig
- 1/4″ through 12″ sizes with carbon steel, stainless steel, bronze, ductile iron, aluminum, and polyvinyl chloride bodies standard (others available). Screwed, flanged, socket, or special end connections
- Two-way flow . . . driptight shutoff in either direction . . . and double leaktight stem sealing
- Automatic and remote control with pneumatic or electric operators

The line is *complete*—write or phone for details today



Top-entry McCannaseal valve with "wedge-seat" design that automatically compensates for wear.



Compact, reliable pneumatic or electric operators for automatic and remote control.

what these valves really control is cost!

Valves and parts stocked nationwide by leading industrial distributors.

HILLS-McCANNA COMPANY

400 MAPLE AVENUE, CARPENTERSVILLE, ILLINOIS

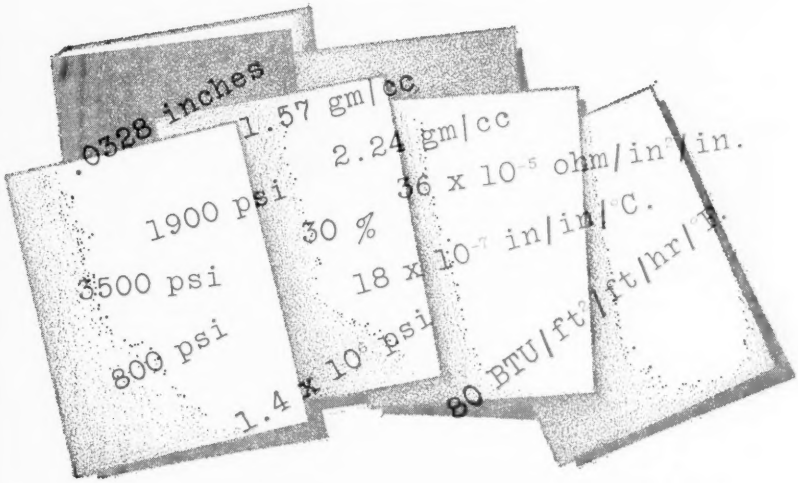
Hills-McCanna (Canada) Ltd, 920 Mattawa Avenue, Summerville (Toronto), Ontario

BV61-3

Ask for Catalog No. 1200—specifications, temperature-pressure relationships, C_V values, dimensions, weights, materials, and service recommendations. You can select the valves you need directly from these pages. Write today.

NEW TECHNICAL DATA SHEETS AVAILABLE TO GLC ANODE CUSTOMERS

Recently issued data sheets prepared by our Technical Department contain important information about graphite anode properties.



Among the typical physical properties detailed for anodes in various grades and sizes are maximum particle sizes... apparent and real density... porosity... resistivity... rupture... compressive and tensile strength... elasticity... thermal expansion and conductivity.

Typical chemical properties of the anode grades show percentages of ash, sulfur, silicon, iron, calcium, aluminum, vanadium sodium, titanium and other impurities.

Data on the surface finishing obtainable in various machining operations are also included.

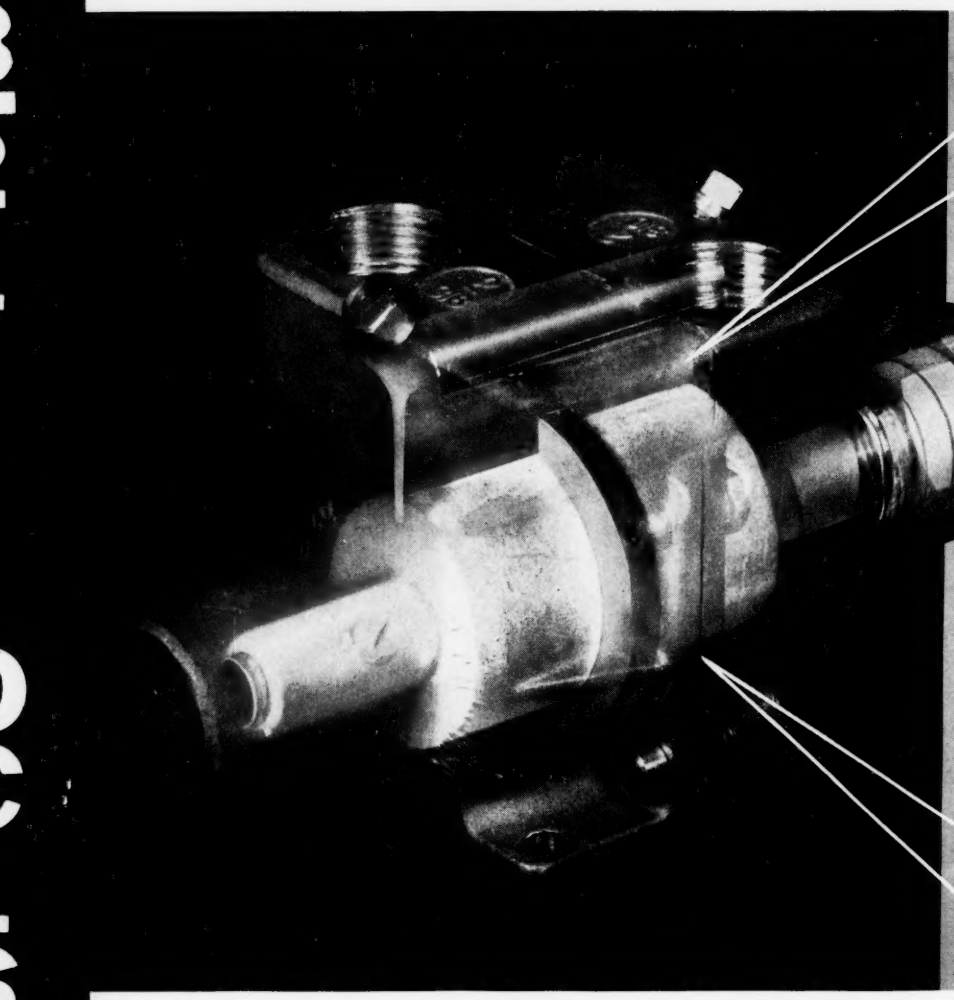
We shall be happy to furnish a set of these technical data sheets, with our compliments, to anode users everywhere. Your request will be most welcome.

PRODUCTS ELECTRODE GLC DIVISION YOU CAN TRUST

GREAT LAKES CARBON CORPORATION

18 EAST 48TH STREET, NEW YORK 17, N. Y.

LOOK INTO...
ECO ALL-CHEM® PUMPS



Twin opposed oscillating impellers provide linear non-segmented, non-foaming flows ideal for shear-sensitive emulsions and safe for auto-detonating fluids. Capacities to 10 gpm, pressures to 75 psi, viscosities to 900 SSU.

Drives; direct electrical motor, air motor, pulley, sprocket, and hydraulic or mechanical variable speed drives.

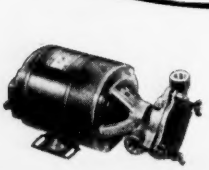
Designed for severe corrosive service. Housing and Shafts; 304, 316 and Carpenter 20 stainless steel or Hastelloy* B and C. Impellers; Teflon†, phenolic or polyamide resins, Hypalon†, etc. Bearings and Seals; self-lubricated Teflon.

ECO

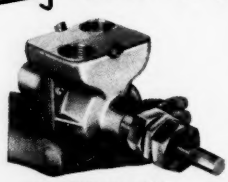
the big-name in small pumps for the process industries

Write for Literature on any or all of the Eco stock pumps shown below for handling corrosive or hazardous processing fluids.

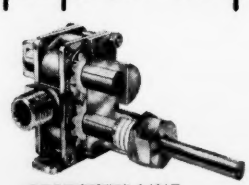
*Union Carbide Trademark. †du Pont Trademarks.



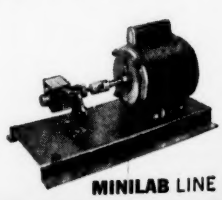
CENTRI-CHEM LINE



ALL-CHEM LINE



GEARCHEM LINE



MINILAB LINE

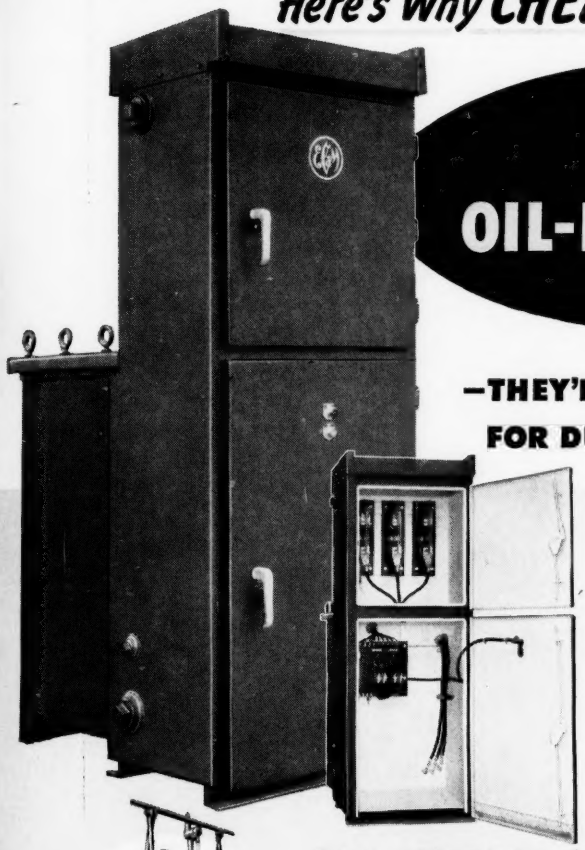
ECO ENGINEERING COMPANY • 12 New York Avenue • NEWARK 1, N.J.

Here's Why **CHEMICAL MEN** *specify...*

EC&M OIL-BREAK STARTERS

(2200-4800 VOLTS)

—THEY'RE *Specifically Designed* FOR DUSTY, CORROSIVE ATMOSPHERES

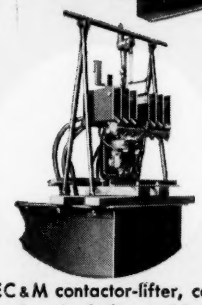


Exterior and interior views of EC&M Type ZHS High Voltage Starter in NEMA 3R (raintight) enclosure with threaded connections for conduit

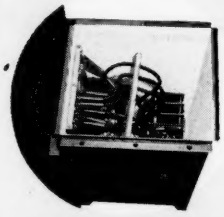
EC&M Type ZHS Starters are a "natural" for chemical plant service because the high interrupting capacity ZHS contactor operates under oil. Being totally oil-immersed, this contactor is always well lubricated, protected from corrosion and requires infrequent inspection. There are additional advantages—

QUICKLY INSTALLED because starters are shipped with all internal wiring complete. These ready-to-use starters cut installation time and cost.

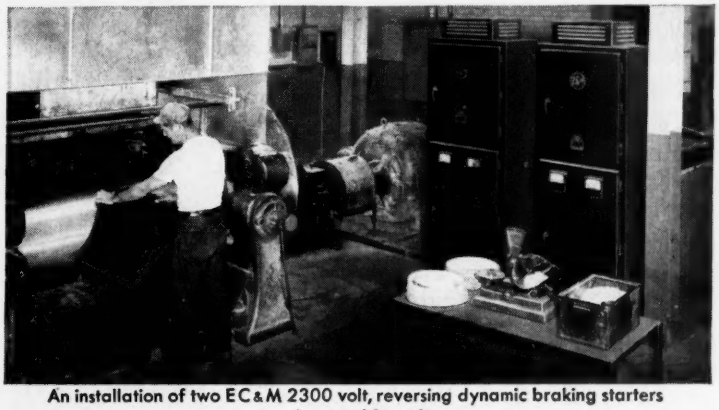
HIGH INTERRUPTING CAPACITY • These EC&M Starters are available in enclosures for indoor or outdoor mounting, and are supplied in 3 ratings—*(1)* 50,000 KVA (certified) interrupting capacity (inherent in the starter)—*(2)* with power-type, current-limiting fuses—*(3)* VALIMITOR® (volt-ampere-limitor), the bus may be of unlimited KVA.



With EC&M contactor-lifter, contactor is easily raised above oil level for easy inspection without disconnecting any bolts or leads



Down-view into oil tank. Note compactness of contactor and transformer assembly. All leads are anti-syphon



An installation of two EC&M 2300 volt, reversing dynamic braking starters in a large rubber plant

For the complete story, write for Bulletin 8130

SQUARE D COMPANY

EC&M DIVISION • CLEVELAND 28, OHIO

wherever electricity is distributed and controlled

8170

"LOWER MAINTENANCE COSTS START HERE— WITH TOP-QUALITY DU PONT PAINTS!"

"Corrosion like this really eats away at profits," observes Joe Mulvey, of Du Pont's special Technical Service Group. "Which is why it pays to insist on a carefully planned program of effective maintenance painting—to clamp down on costs and enjoy maximum return on every paint dollar you spend.

"With Du Pont you get both effective finishes and careful planning. It starts with paints of the finest quality, chemically engineered to do a given job – and do it right. Like our new IMLAR(TM) Vinylmastic Coatings and Vinyl Enamels, for severe acid conditions... CORLAR(TM) Epoxy Enamels, for outstanding resistance to chemical spills, fumes and moisture... or DULUX® Metal Protective Primers and Top Coats, that can handle 85% of your general maintenance needs.

"But just as important as the paints you use is how you use them. And that's where Du Pont's well-known technical assistance comes in. We study your problems at firsthand, where they occur. Then we're in a position to sit down and map out a program of protection geared to specific conditions in your plant. It adds up to this: effective, long-term maintenance, at lowest cost per square foot per year!"

Over 20 years' experience with corrosion problems makes Joe Mulvey typical of the able, expert help you can expect from Du Pont. Why not call your local Du Pont district sales office the next time you have a corrosion problem? For facts on the finishes mentioned here, just clip and mail the coupon below.

E. I. du Pont de Nemours & Co. (Inc.)
Finishes Division, Department CE-110
Wilmington 98, Delaware

Please send me, without obligation:

- ☐ Technical bulletin on IMLAR
- ☐ Technical bulletin on CORLAR
- ☐ Technical bulletin on DULUX Metal Protective Finishes

Name_____

Firm_____

Address_____

City_____ Zone____ State_____

MAINTENANCE PAINTS

DU PONT
REG. U.S. PAT. OFF.

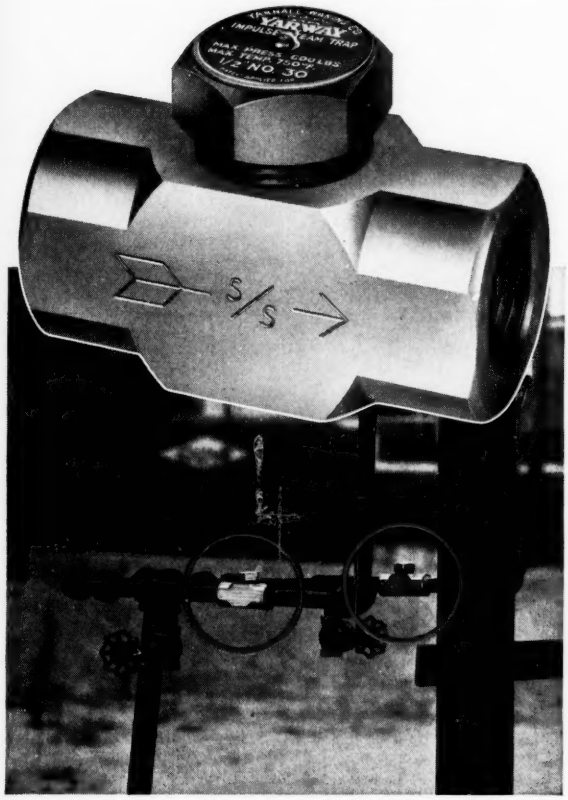
BETTER THINGS FOR BETTER LIVING ...*THROUGH CHEMISTRY*

YARWAY news briefs

from **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD
STEAM TRAPS STOCKED AND SOLD BY 270 LOCAL INDUSTRIAL DISTRIBUTORS

YARWAY SERIES 30 IS THE STEAM TRAP FOR PEAK EFFICIENCY



Two Yarway Series 30 traps on tracer lines from a loading station to polystyrene storage tank at the Midland Division of The Dow Chemical Co., Midland, Mich. Steam pressure is 150 pounds.

on tracer lines, main drips, meter boxes and other steam equipment

Yarway Series 30 Impulse Steam Trap has won enthusiastic acceptance and scored outstanding success on those hundreds of applications where condensate is handled in moderate amounts. Here's why:

- Economy of operation, with closer condensate control
- Longer service life, with lever action reducing impact on valve seat
- Lower maintenance, with easily and quickly replaceable seat and disc
- High quality, all stainless steel—combined with a new low cost

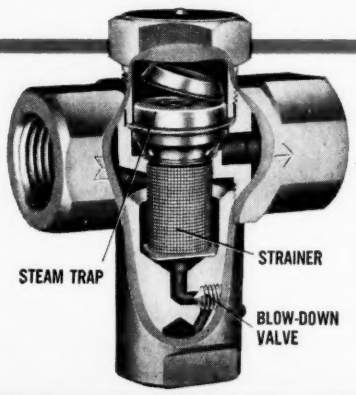
Here are a few typical user experiences:

TEXAS REFINERY—*Been using ½" No. 30's on drip legs to steam lines for 6 months. "No troubles whatsoever."*

PENNSYLVANIA TIRE MFR.—*Gradually replacing all traps on tire molds with Yarway No. 30's. "Amazed at their performance."*

MISSOURI STEEL PLANT—*Tested Yarway No. 30's against competitive traps, with result "Yarway No. 30 now standard on all main steam header drips."*

So it goes in plant after plant. Why don't *you* try Yarway Series 30 Traps? Available in ⅜" or ½" size; pressures 8 to 600 psi. Your nearby Industrial Distributor carries them. Write for his name.



NEW! COMPACT COMBINATION

NEW SERIES 130 steam trap combines a Series 30 trap, a strainer, and blow-down valve *all in one compact unit*—with these advantages:

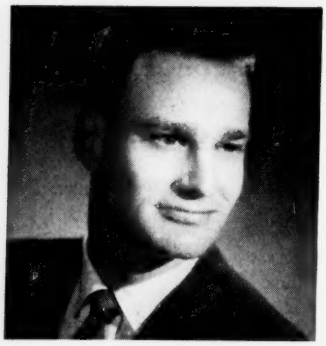
- Saves space
- Saves installation costs
- Saves weight
- Saves on maintenance

Stainless steel construction, good for all pressures 8 to 600 psi.

Your Yarway distributor has SERIES 130 traps. Try one today—or write for new Bulletin T-1743-B.

News from
National Carbon Company
Division of Union Carbide Corporation · 270 Park Avenue, New York 17, New York
In Canada: Union Carbide Canada Limited, Toronto 12

National Carbon Representatives Expand Your Engineering Force



W. R. HEWITT
Sales Engineer

Mr. Hewitt joined National Carbon Company in 1955 as sales and service engineer handling the application of activated carbon to purification, separation, and recovery of gases and liquids.

Currently he is a field engineer in the Pacific Northwest area for carbon, graphite, and "Karbate" impervious graphite products.

Mr. Hewitt was graduated from M.I.T. with a B.S. degree in General Engineering.

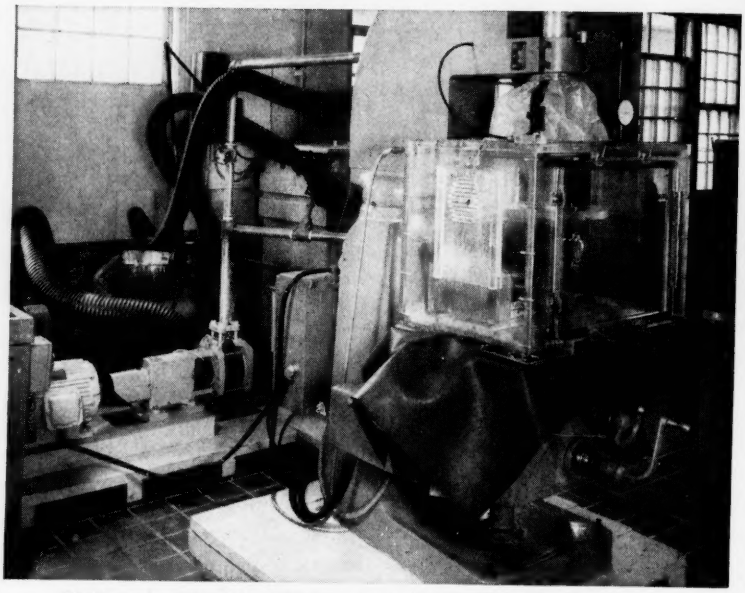
New Frame-mounted Models Expand "Karbate" Pump Line

The frame-mounted Type F pump expands to 32 the number of standard "Karbate" impervious graphite centrifugal pumps now available.

With discharge openings of 1½ and 2 inches, capacities to 140 gpm, and heads to 67 feet, this pump features the same wet end parts and mechanical seal used on "Karbate" motor-mounted models.

For detailed information on the features of "Karbate" centrifugal pumps, write for **Catalog Sections: S-7251, S-7253 and S-7254.**

Same "KARBATE" Pump Handles Wide Variety of Tough Corrosives



Plastic chamber with workpiece, electrodes, and electrolyte. "Karbate" Type F pump at left.

Because of unsurpassed corrosion resistance, "Karbate" impervious graphite centrifugal pumps are being used to handle various chemical solutions used as electrolytes for electroshaping intricate metal parts.

This electrochemical process, developed under sponsorship of Steel Improvement and Forge Company, Cleveland, permits the shaping of jet engine compressor blades in approximately 1/10 the time required with standard machine tools.

The "Karbate" frame-mounted Type F unit pumps the various types of electrolytes through the electrolytic cell. The pump operates at 3600 rpm, thus providing the high flow rate past the electrodes required to control temperature and maintain proper in-solution metal ion balance.

"Karbate" Pump Gives Trouble-free Service in 0° C. Application

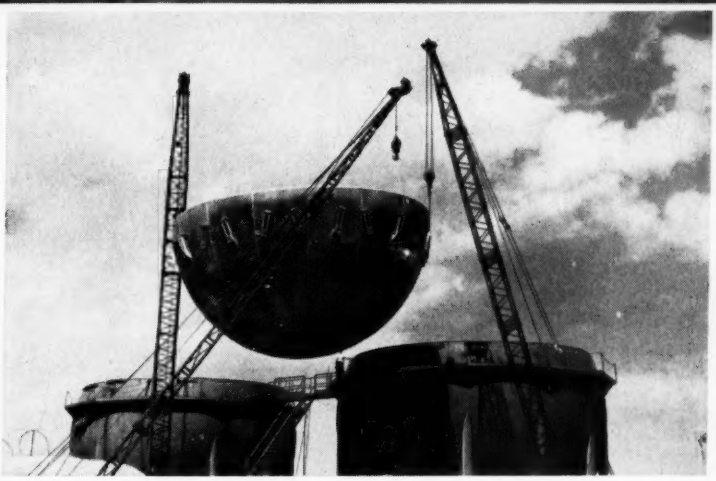
An eastern chemical manufacturer has reported trouble-free operation of a "Karbate" impervious graphite Type F Model FBL centrifugal pump handling an acid solution of aluminum chloride at 0° C. In ten months of service only periodic seal adjustments have been required. The pump is equipped with the standard carbon-to-carbon rotary seal arrangement.

No other corrosion-resistant material can handle as wide a range of corrosives at temperatures from below zero to 340°F.

"National", "Union Carbide", "N" and Shield Device and "Karbate" are registered trade-marks for products of
NATIONAL CARBON COMPANY
UNION CARBIDE

FOR LINDE AT HUNTSVILLE, ALA. BY PDM STEEL COMPANY

320°F BELOW ZERO STORAGE FOR LIQUIDS IN SPHERES-WITHIN-SPHERES

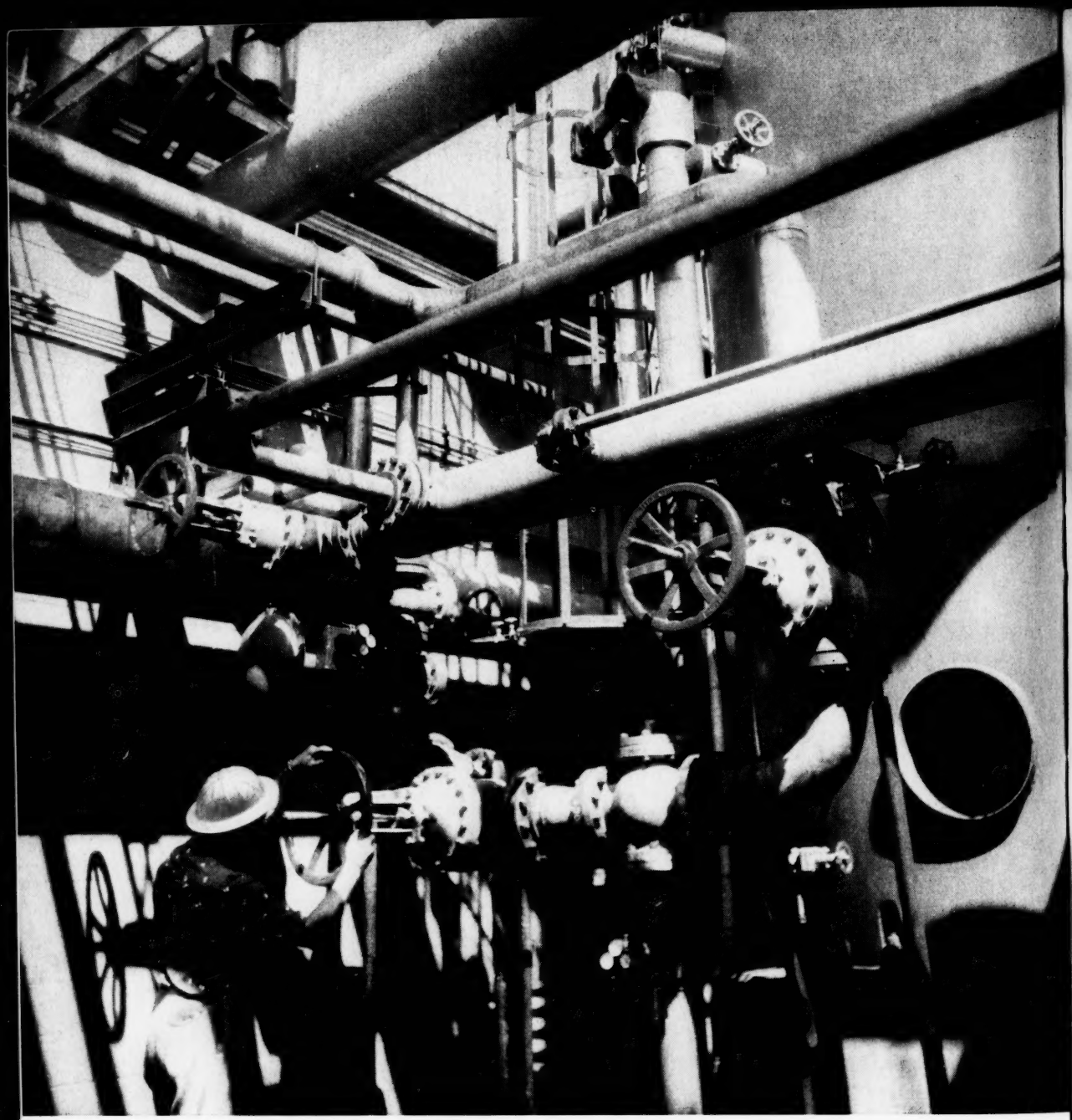


A hollow ball of aluminum alloy, nested within a carbon steel shell. That's the inside story of these PDM-built cryogenic storage spheres for liquefied gases, using Linde-approved designs. Holding liquid nitrogen at a sharp −320°F, and liquid oxygen at −297°F, the vessels are essential units in the tonnage production of both gases at the new Huntsville, Ala. plant of Linde Company, Division of Union Carbide Corporation. A specially-designed rod support system suspends the 39′ dia. inner spheres within their outer steel shells. Several feet of powdered insulation between the walls slows heat transfer almost to a halt. Structures like these, among the largest of the type ever built, prove PDM's mastery of cryogenic construction techniques, based on many years of application in this field. • We welcome your inquiries, and will be glad to quote on your specific cryogenic storage requirements.

PITTSBURGH-DES MOINES STEEL COMPANY

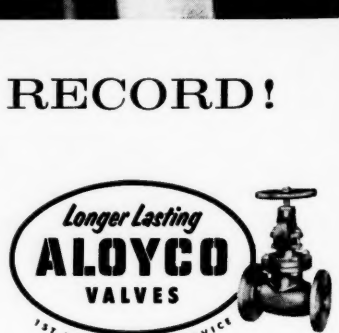
Plants at PITTSBURGH, WARREN, BRISTOL, PA. • BALTIMORE • BIRMINGHAM • DES MOINES
PROVO, UTAH • CASPER, WYO. • SANTA CLARA, FRESNO, STOCKTON, CALIF.

PITTSBURGH (25)	Neville Island	EL MONTE, CALIF.	P.O. Box 2012
WARREN, PA.	P.O. Box 660	NEW YORK (17)	200 East 42nd Street
BALTIMORE (26)	P.O. Box 3459, Curtis Bay Station	NEWARK (2)	744 Broad Street
BIRMINGHAM (8)	P.O. Box 8641, Ensley Station	CHICAGO (3)	679 First National Bank Bldg.
DES MOINES (8)	1015 Tuttle Street	ATLANTA (5)	361 East Paces Ferry Rd., N.E.
PROVO, UTAH	P.O. Box 310	DALLAS (1)	Suite 1703, Southland Center
SANTA CLARA, CALIF.	P.O. Box 329	DENVER (2)	323 Railway Exchange Bldg.
		SEATTLE (1)	500 Wall Street



3 YEAR PERFORMANCE RECORD!

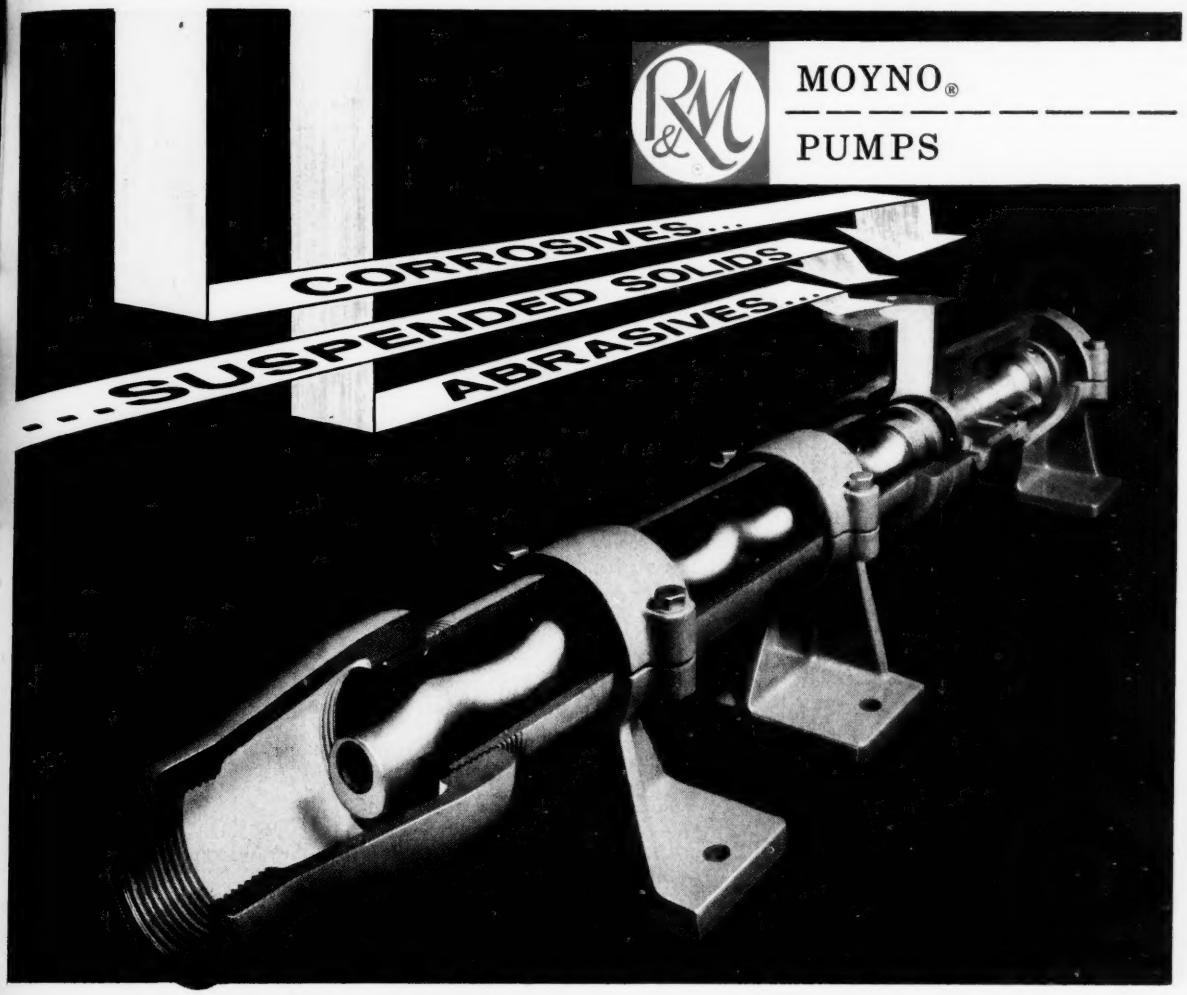
General Aniline & Film Corporation's plant at Linden, New Jersey, has now been on stream for 3 years. It produces ethylene oxide by direct air oxidation of ethylene through an original process. Aloyco Stainless Steel Valves were selected for their design features and long life expectancy. This proved out when three consecutive years of satisfactory performance was recently reported. Shows what you can expect when you talk to the *one* company which specializes in high alloy stainless steel valves exclusively. If you seek long term economical performance on your next stainless steel valve job—let Aloyco specialists help save time and money for you. For more information, write us at 1301 West Elizabeth Avenue, Linden, New Jersey. 19



ALLOY STEEL PRODUCTS COMPANY

SUBSIDIARY OF WALWORTH COMPANY

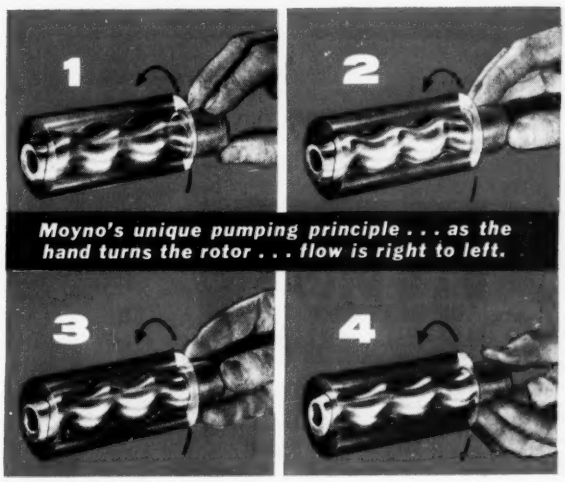
Boston • Wilmington • Atlanta • Birmingham • Baton Rouge • Buffalo • Pittsburgh • Chicago • St. Louis • San Francisco • Los Angeles • Seattle



MOYNO® *solves tough pumping problems!*

Moyno's "progressing cavities" successfully handle thin watery slurries, non-pourable abrasives, gnawing corrosives or suspended solids up to 1⅛" dia.—without crushing, foaming or aerating! Material contacts only one moving part, a screw-like rotor revolving in a double-threaded stator. Where corrosives or abrasives are to be handled, rotor and stator are made of special resistant materials that minimize maintenance and prolong pump life. Many materials now pumped by Moyno were once considered "unpumpable" . . . had run up prohibitive maintenance costs on other type pumps or ruined them completely!

Moyno pumps are available in capacities to 500 gpm; pressures to 1000 psi. Learn more . . . write today for new Bulletin **100-CE!**



Moyno's unique pumping principle . . . as the hand turns the rotor . . . flow is right to left.

ROBBINS & MYERS, INC., Springfield, Ohio

Fractional and Integral HP Electric Motors • Electric Hoists and Overhead Traveling Cranes • Moyno® Industrial Pumps
Propellair® Industrial Fans • R & M-Hunter Fans and Electric Heat • Trade-Wind Range Hoods and Ventilators
Subsidiary companies at: Memphis, Tenn., Pico Rivera, Calif., Brantford, Ontario.

To produce inerts in any quantity, for any job . . .

KEMP INERT GAS GENERATORS

—are best 3 ways!

1. Easy to start, set and forget

With Kemp's unique carburetor and external test burner, you check the pre-mixed gas-air ratio *before* it enters the combustion chamber . . . start fast with the electric ignition. Then set the vernial dial and forget it! The carburetor maintains the exact air-gas ratio—no rechecking needed.

2. Precise fuel control

You'll find the Kemp Carburetor automatically pre-mixes and keeps gas and air at the exact mixture you wish. And no matter what the total demand or pressure changes in your supply line, this precise air-gas ratio is maintained at all times.

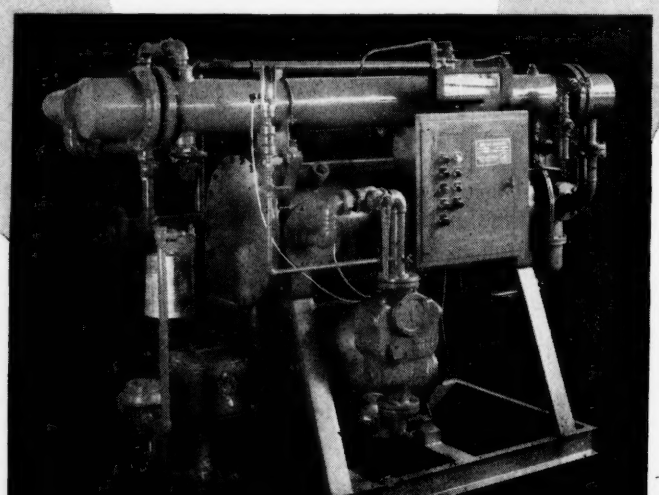
3. Automatic safety

Kemp safety controls eliminate the danger of flame-out. An electronic flame-failure control instantly, automatically cuts off the carburetor's gas supply. This control operates under all conditions . . . unaffected by moisture or combustion chamber pressure.

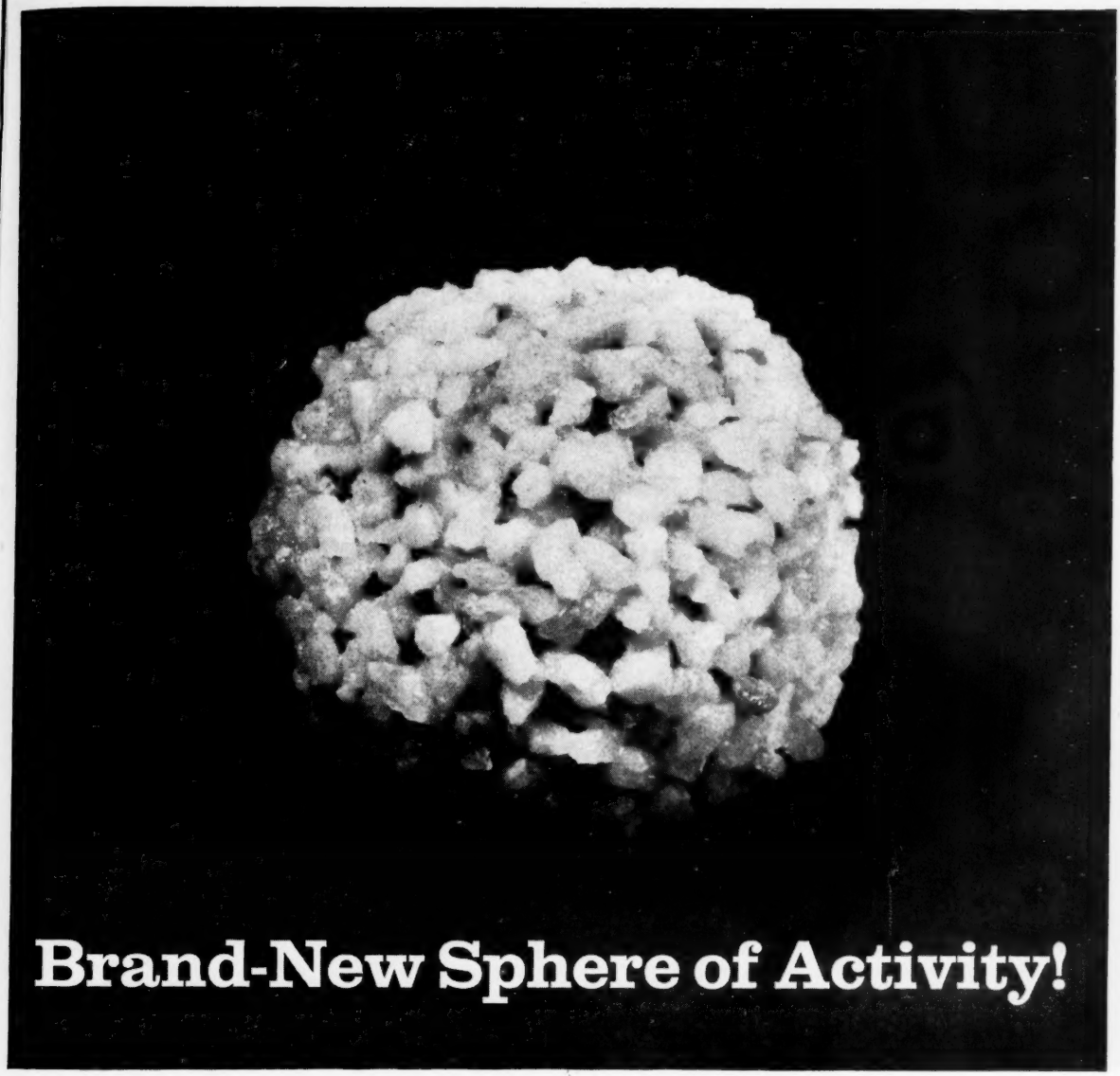
If you need inert gases for blanketing, purging and protective uses, write for Bulletin L-10 . . . or call in your Kemp Man listed in the yellow pages or the Chemical Engineering Catalog.

It always pays to come to

KEMP
OF BALTIMORE



THE C. M. KEMP MANUFACTURING COMPANY
405 E. Oliver Street • Baltimore 2, Maryland



Brand-New Sphere of Activity!

Here is a MACROPORT* "A" aluminum oxide sphere — Norton Company's newest development in catalyst carriers shown enlarged. Note its extremely porous structure, specifically designed to promote *faster, more precisely controlled* gaseous reactions. Pores are much larger than those in other Norton catalyst carriers, permitting gases to enter and diffuse readily, yet providing sufficient restriction for optimum control.

MACROPORT "A" catalyst carriers are currently available as spheres, pellets, and aggregate of fused aluminum oxide in the same price ranges as standard Norton carriers. A research program is now underway in the Norton laboratories to develop MACROPORT carriers in other materials.

For better yields from *your* reactors and improved process economy, get complete details on Norton MACROPORT "A" carriers. Write NORTON COMPANY, Refractories Division, 509 New Bond Street, Worcester 6, Massachusetts.

TYPICAL PHYSICAL PROPERTIES

	MACROPORT "A" 5/16"-⅜" Spheres	Aggregate (3-5 Mesh)
Apparent Porosity %	44-48	40-44
H_2O Absorption %	22-26	18-22
App. Sp. Gravity g/cc	3.4-3.6	3.4-3.6
Bulk Density g/cc	1.8-2.0	2.0-2.2
Packing Density lbs./ft³	63-67	68-72
Pore Dia. Range	50-200 Microns	50-200 Microns

*Trademark

NORTON
REFRACTORIES
Engineered... Rx ...Prescribed

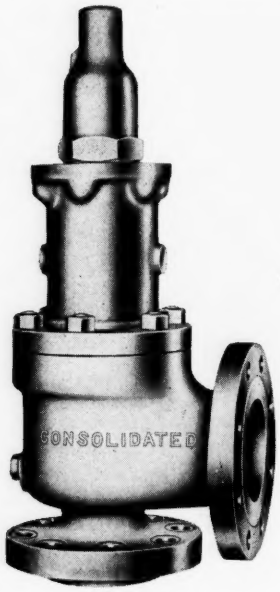
75 years of . . . **Making better products . . . to make your products better**

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — **BEHR-MANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

seal

CONSOLIDATED SAFETY RELIEF VALVE'S Sealing Bellows protects against damage from contaminants, corrosion, or viscous fluids

saves



Consolidated Safety Relief Valves are available in both Balanced Bellows and Standard designs. The Standard type has an eductor tube that effectively removes bonnet pressure.

Balanced Bellows Type Consolidated Safety Relief Valves have a durable, two-ply stainless steel Sealing Bellows that isolates and protects working parts from destructive elements in the lading fluid.

The bellows is balanced with the seating surface. Even with superimposed back pressure in the relieving system, valve performance is consistently stable and dependable. The bellows does not affect the high capacity of the valve, nor does it require change in set pressure. Even the blowdown adjustments are limited.

Additionally, Consolidated Safety Relief Valves now offer a no-leak tightness maintained by a resilient "O" Ring Seat Seal retained in the valve disc. This Seal assures tightness at operating pressures far closer to set pressure than with metal-to-metal seats alone, yet does not carry the seat load imposed by the spring. The Seal also takes piping strains much better than all-metal seating.

The Sealing Bellows and "O" Ring Seat Seal are typical of the extra quality built into Consolidated Safety Relief Valves to assure absolute protection for personnel and plant. These fine features plus flat seating and single ring construction also eliminate many maintenance problems and costs. Write for Catalog 1900 and Bulletin 1940.

MAXWELL MANNING MM& & MOORE INC. TRADE MARK

CONSOLIDATED SAFETY RELIEF VALVES

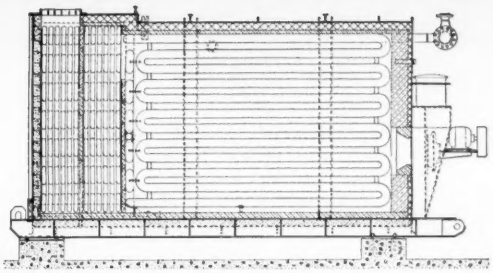
A product of

MANNING, MAXWELL & MOORE, INC.

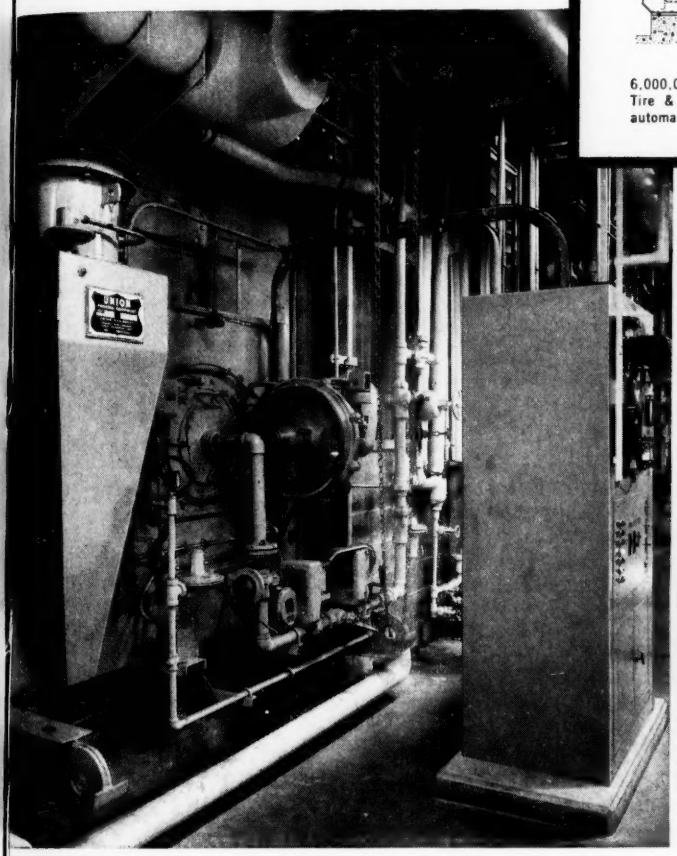
Valve Division • Tulsa, Oklahoma

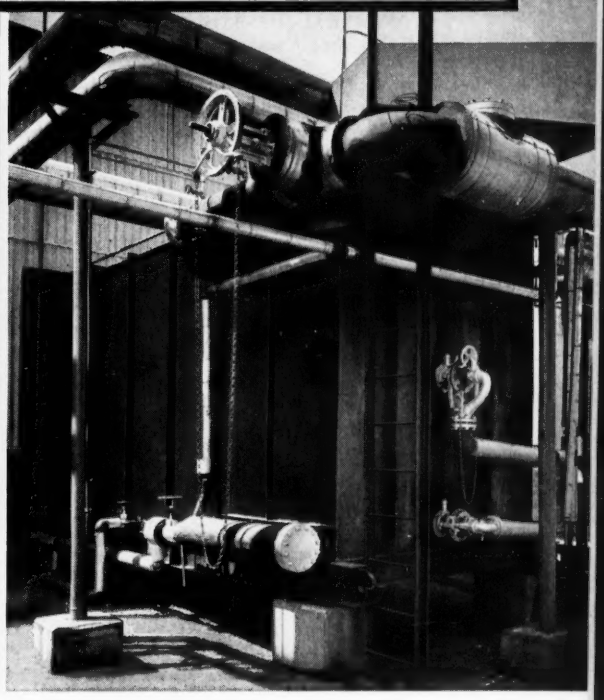
Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario
Latin America: Export Division, Chrysler Building, New York, N. Y.
Europe: Manning, Maxwell & Moore, S. A., Fribourg, Switzerland

UNION SHOP ASSEMBLED ORGANIC LIQUID HEATERS . . .



6,000,000 BTU/hr. FORCED CIRCULATION LIQUID HEATER serving Goodyear Tire & Rubber Company's plant in Point Pleasant, West Virginia. Fully automatic. Gas and oil fired.





lower exit flue gas temperatures spell fuel savings

Built to ASME Power Boiler Code requirements, Union Forced Circulation Liquid Heaters save fuel dollars.

Liquid and gas flow are counter current. The lowest temperature liquid is served by the lowest temperature gas. This assures maximum thermal efficiency and minimizes the risk of thermal shock. Outlet temperatures can be precisely controlled.

High liquid velocities (8 to 10 ft./sec.) and liberally proportioned, liquid cooled furnaces eliminate localized overheating. As there are no multi-tube circuits in the radiant section, recirculation within a circuit is impossible, thereby eliminating vapor binding or stagnant flow areas.

Horizontal design provides ready access to facilitate operation and maintenance.

Designed for use with Dowtherm "A" and "E", Aroclor #1248, organic heat transfer oils, and other commercially available fluids, standard units (both field erected and shop assembled) can be modified to meet a wide range of job requirements. They can be arranged for firing with most commercial fuels as well as waste fuels in liquid or gaseous form.

For specific information, contact your local Riley Stoker or Union Iron representative.

UNION

UNION IRON WORKS
ERIE, PENNSYLVANIA
A DIVISION OF RILEY STOKER CORP.

Are you one who says

"What the heck... all Raschig Rings are alike!"

If you are — you'll be interested in the two tables shown in this ad. We had our engineering department purchase several cubic feet of 1" porcelain raschig rings from our two principal competitors — asked Stoneware research to compare them with ours. The tables give the answers.

Two points stand out to the buyer of raschig rings who wishes to get the most for his money. (1) The lower packing factor of our rings results in a pressure drop 15% - 20% lower which means greater capacity for your tower, or lower pumping costs. (2) The longer service life of our rings in corrosive service not only saves on replacement costs but assures maintenance of low pressure drops for a longer period.

There are good reasons for our better quality. The porcelain body from which our rings are made has been developed solely for this type of service. It has no porosity. It is extruded through Alite high alumina dies which assures uniform wall thickness. It is fired under precisely controlled conditions. The result is the best porcelain raschig ring available anywhere in the world.

	Our 1" O.D. Rings	Mfr. "A" 1" Rings	Mfr. "B" 1" Rings
Wall thickness	0.130"	0.162"	0.165"
Surface Area (Sq. ft. per cu. ft. of packing)	57.6 sq. ft.	56.0 sq. ft.	55.6 sq. ft.
Weight per cu. ft.	42 lb.	51 lb.	50 lb.
Free Space	72.5%	66.3%	67.0%
Packing Factor	160	207	203

	Our Porcelain Rings (1"x1"x1/8")	Mfr. "A" Rings (Thicker Walls)	Mfr. "B" Rings (Thicker Walls)
Weight change after 2 weeks in boiling 72% H_2SO_4	0.44	1.40	8.4
Ditto after 4 weeks	0.93	5.60	*
Breaking strength in lbs. of new rings before acid boiling test	130	144**	191**
Breaking strength in lbs. AFTER 4 weeks in boiling H_2SO_4	134	75	*

*Mfr. "B's" rings fell apart during the third or fourth week, preventing us from getting any further weight or strength data.

**Rings of both Mfr. "A" and Mfr. "B" are naturally stronger when shipped, because of their substantially thicker walls.

When you're tempted to save a few cents per cubic foot by buying a lower cost ring, remember you'll be dollars ahead by buying ours.

PROCESS EQUIPMENT DIVISION

U. S. STONEWARE

AKRON 9, OHIO

64-H

Top news stories and what they mean to CPI technical decision-makers

Chementator

Reverse-spin rotors give high hydraulic shear with low power

A novel mixer design, which might also prove practical in other applications, is being used by Emerson Mfg. Co., Lawrence, Mass., in a new repulping machine. Proved on a commercial scale at the Gilman, Vt., mill of the Gilman Paper Co., the unit is claimed to defiber pulps twice as fast as other machines—with only half of the energy input.

The pulper derives hydraulic shear from two counter-rotating, coaxially-mounted vaned rotors. Both are driven by a single motor through a right-angle drive beneath the cylindrical mixing chamber. The stream of stock emanating from the inner rotor, moving counterclockwise, passes directly into the vanes of the outer rotor, which rotates clockwise. The abrupt reversal in direction at an interfacial speed of 6,000 ft./min. furnishes the energy for defibering.

Flow of fluid in the mixing chamber follows the contour of a doughnut: stock from the outer rotor flows radially to the walls, then upward and radially back to the center, and finally back down to the rotors. Flow is relatively slow and controlled, since most of the energy is absorbed by the fibers at the rotor interface, and little power is consumed in circulating the stock.

The Gilman unit can completely defiber 2,000 lb. of unbleached kraft pulp in about seven minutes, using a 300-hp. motor to drive the rotors.

EJC's advice to companies: take inventory of critical manpower now

A do-it-yourself kit to aid companies in taking inventory of critical manpower has just become available from the Engineering Manpower Commission of Engineers Joint Council (EJC). The twofold purpose of the inventory program is (1) to give employers a method to analyze the draft liability of their employees and (2) to provide the Selective Service System with information that will be invaluable in any national emergency.

According to S. B. Ingram, chairman of the Manpower Commission, "present safeguards are inadequate to prevent the wholesale withdrawal of engineering and scientific manpower from industry in a national emergency."

This situation prompted the commission to put together a survey kit that supplies condensed information on critical-employee draft status. It shows a company how to determine its balance between critical and noncritical personnel, and indicates probable order of call to armed services in a national mobilization.

In similar fashion, the survey will show Selective Service the critical areas of personnel selection. Ingram emphasizes that adequate manpower planning can only be accomplished before the onset of crisis conditions. Although draft rolls are now being filled without affecting the deferments of engineers and scientists, in a crisis there may not be time to identify men whose skills are critical—with consequent disruption of industrial production.

Manpower inventory kits are now being mailed to 1,000 firms that employ almost 92% of all engineers.

Epoxies build high hopes on new low-density foams

Recent technical developments that reduce densities and handling difficulties have put epoxy foams into earnest competition for fast-growing rigid-foam markets.

Formerly limited to uneconomical densities above 5 lb./cu. ft., epoxy foams averaging 2.3 lb./cu. ft. result from a new series of foam systems offered by Shell Chemical. Described by Shell's R. P. Toohy at last month's AIChE meeting in Lake Placid, the new foams are dispensed by either conventional foam-in-place techniques or by spray equipment. (Earlier epoxy

BENZENE:

Shell increases benzene capacity 500 per cent. Can now fill orders anywhere from 3 refineries. Mammoth storage system can make benzene available on a local basis.

Shell now has the largest benzene-producing capacity in the world. It exceeds 80 million gallons a year. An increase of nearly 500 per cent in less than 18 months.

Shell benzene now comes from 3 refineries. You can take delivery by barge, truck or tank car—depending on your location.

You can get all the benzene you need, when you need it. Read the facts below.

THE DEMAND for benzene has soared. New uses are coming along every year. Shell has answered the need with a massive increase in capacity.

Bigger supplies now

Shell's annual benzene production capacity tops 80 million gallons of high purity product. *Production and distribution facilities are nationwide.*

Three Shell refineries can now produce benzene: Wood River, Illinois; Houston, Texas; and Wilmington, California.

Shipments come by barge, tanker, tank car or truck

All three are located near waterways to make possible direct barge or tanker shipments—a great potential saving. Shipment can also be made by tank car or transport truck.

Shell's production and storage points are strategically located to facilitate supply of high purity benzene (see map above). All Shell's benzene-producing refineries are on major waterways. Inland locations make possible delivery by tank car, truck or barge.

Wherever the demand justifies, Shell's enormous nationwide storage facilities (see map) can be used for benzene. Strategically located across the country, these facilities make Shell benzene potentially available on a local basis.

Shell benzene is Thiophene-free

Manufacturers choose Shell benzene when quality must be consistently high. It is Thiophene-free.

For full facts about Shell benzene, contact your Shell Industrial Products Representative. Or write: Shell Oil Company, 50 West 50th Street, New York 20, New York.

SHELL

A Bulletin from Shell
—where 1997 scientists are working to provide better products for industry

foams were available only as pour-in-place systems, powdered pack-in-place systems or in various prefoamed shapes and parts.)

As a result, epoxy foams are now competitive in cost with other types of liquid foam systems.

At stake is a rigid-plastic-foam market that is expected to quadruple by 1966 to nearly 400 million lb./yr. Special target for epoxies: low-temperature insulation, where demand for rigid foams is expected to go to 80 million lb./yr. by 1966. Thermal insulation values for these new low-density epoxy foams are equivalent to the lowest values obtained with either conventional insulation or other foams.

Shell's new series of proprietary resins is based on bisphenol-A-epichlorohydrin polymers that have been combined in solution with chlorofluorocarbon blowing agents. Second component is a curing agent. The new foams are classified as one-shot systems because no intermediate chemical manufacturing step is necessary between the raw-material manufacturer and the end-user to control the heat of reaction, excess vapors or resultant foam properties.

Enjay Chemical will soon be the third company in the methyl isobutyl ketone market. Enjay's parent, Humble Oil & Refining, is adding an MIBK unit, due on stream in mid-1962, to its Bayway, N. J., refinery. Other two major producers are Shell Chemical and Union Carbide Chemical.

Integration—forward and back—marks phthalic-plasticizer jumble

Evidently believing that turnabout is fair play, California Chemical's Oronite Div. is pondering a move into the phthalic plasticizer business. This would be one phthalic maker's answer to the growing problem of former customers setting up their own phthalic production units.

Oronite will soon start distributing development quantities of its new plasticizer line on the West Coast, *CE* learns. The firm eventually hopes to build up a plasticizer business that would soak up most of the output of its 18-million-lb./yr. phthalic anhydride plant at Richmond, Calif.

Oronite has also announced that it will erect a 30-million-lb./yr. phthalic plant at Perth Amboy, N. J., which is scheduled to come on stream in late 1962. The firm says that the new plant, which is being built by Badger Mfg. Co., is intended only to make Oronite more competitive in the East Coast phthalic market. But if the company's West Coast plasticizer venture turns out successfully, it would be a simple matter for Oronite to move into plasticizers in the East as well.

This latest plant announcement has many industry men questioning the over-all health of the phthalic business. The reason: When all announced plants come on stream, U. S. capacity will total around 840 million lb./yr., while estimated 1965 consumption will be only 500 million lb./yr.

A major factor in the capacity buildup has been a trend on the part of phthalic buyers like Union Carbide, W. R. Grace and Witco to build plants for captive production. Thus the burden of most of the excess capacity will fall to producers such as Allied Chemical, American Cyanamid and Monsanto, who have been the main suppliers of the merchant market.

The feverish activity in phthalic has at least partially answered the question of where all the new petronaphthalene output will be going. Now the question would seem to be: Where is all the phthalic going?

Electrodialysis makes worldwide bid for brine desalination

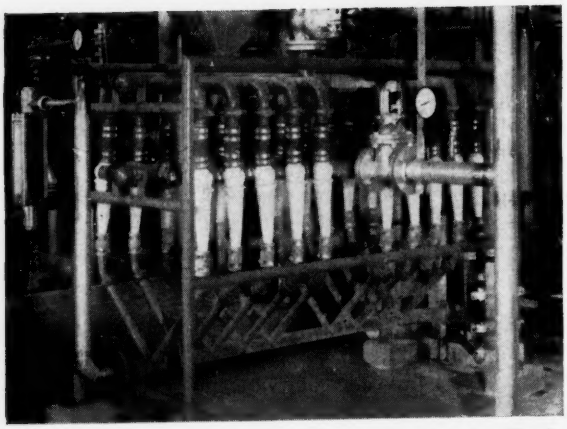
Electrodialysis took significant strides recently in the continuing scramble among the five different major processes that are seeking recognition as economical desalting methods:

• A 250,000-gal./day electrodialysis unit went on stream at Webster, S. D., to provide residents with drinking water containing less than 250 ppm. of dissolved salts. The plant was built for the Office of Saline Water by Asahi Chemical Industry Co., Osaka, Japan, in cooperation with The Austin Co., Cleveland (*Chementator*, Dec. 12, 1960, p. 76).

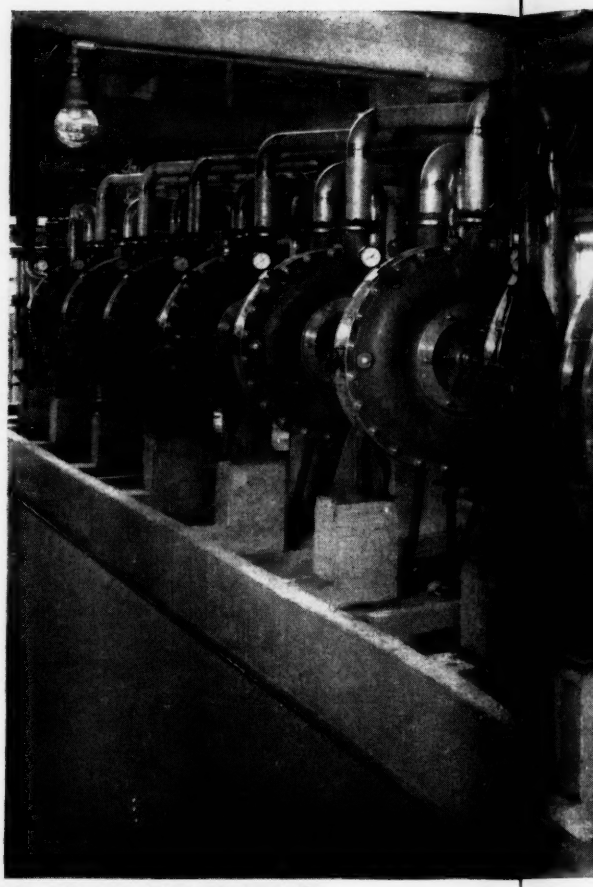
• The Air Force radar station at Pickstown, S. D., will soon be getting fresh water from brackish, via a newly installed 5,625-gal./day plant built by Aqua-Chem, Inc., Waukesha, Wis., under license from T.N.O., a Netherlands research organization.

• Kuwait, a country that already relies heav-

(Continued on page 90)

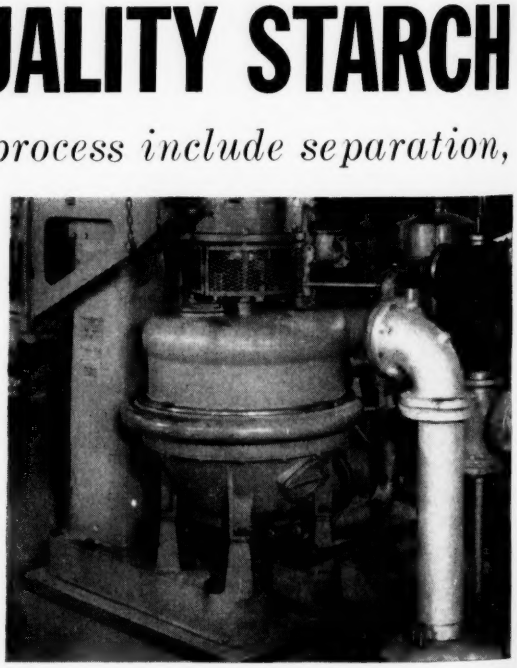


DEGRITTING of underflow from primary Mercos takes place in a 20-unit, two stage P50A DorrClone® system. Grit is removed in a 18-unit first stage and is washed prior to discharge in a 2-unit second stage.

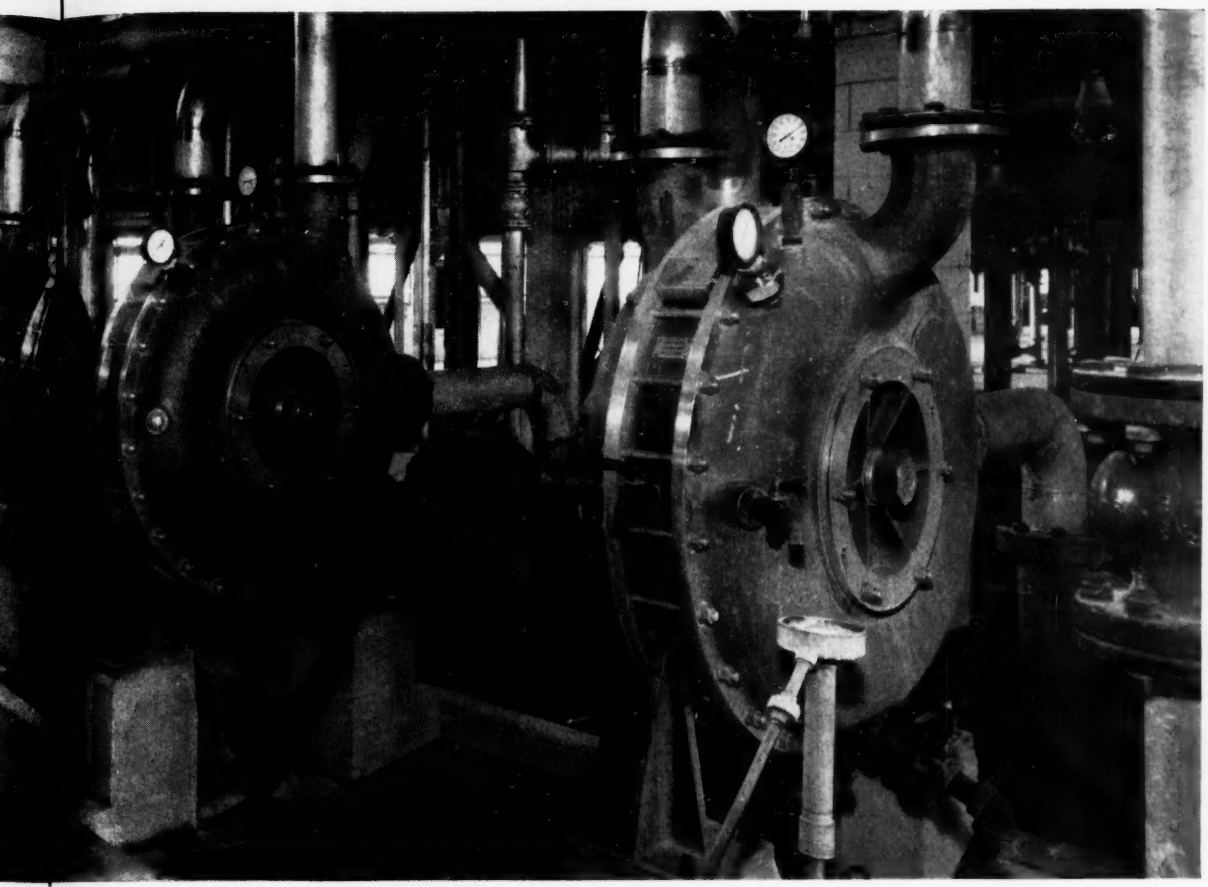


HOW PENICK & FORD PRODUCES TOP-QUALITY STARCH

Stages of continuous process include separation,



CLARIFICATION of middlings product is carried out in Dorr-Oliver's new high-speed Model B-20 Merco® centrifuges. Underflow containing starch and gluten returns to other Mercos for use as wash water.



FINAL SEPARATION and solubles washing is accomplished in this 9 stage DorrClone system using nylon cyclones. Each stage consists of a "clam shell" type DorrClone containing as many as 480 individual 10 mm nylon cyclones manifolded in parallel. System is carefully designed and instrumented to give maximum control of starch product.

H WITH DORR-OLIVER EQUIPMENT

n, concentration, clarification, degritting, washing, straining

Exceptionally pure starch is produced by Penick & Ford, Ltd., using a starch-gluten mixture derived from corn.

"Practically runs itself"—The purification process, an integrated system of Dorr-Oliver equipment, "practically runs itself." Six major operations are performed by this system. Every detail is aimed toward high reliability to insure continuous operation. DorrClone separators, for example, fit perfectly into the picture because they are inherently reliable...contain no moving parts. Further protection is given to the equipment by Merco Rotary Strainers for removal of tramp oversize particles.

This modern plant is an example of accomplishment in food technology. Separation of a starch suspension is only one of a wide range of food and pharmaceutical separation problems you can solve with Dorr-Oliver equipment. If you'd like detailed information on Dorr-Oliver products—or assistance on a specific separation problem—drop a line to the food and pharmaceutical division office nearest you. Dorr-Oliver Incorporated, Stamford, Connecticut, 813 Merchandise Mart, Chicago 54, Illinois, or 2900 Glascock St., Oakland 1, California.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

AT THE CHEM SHOW—DORR-OLIVER BOOTH 531

ily on saline water conversion (with a 6-million-gal./day distillation complex) announced that Ionics, Inc., Cambridge, Mass., will build a 240,000-gal./day electrodialysis plant to provide water for both domestic and agricultural purposes from underground brackish waters.

Competition is strenuous to demonstrate which one has the best—and most economical—process. For example, Asahi edged out Ionics in the bidding for the Webster, S. D., job, but was well above the latter's bid for the contract just awarded by Kuwait. (Second-low bidder for Kuwait was Boby-Bronswerk, an English-Dutch firm under license by T.N.O.)

The largest electrodialysis plant in the world was designed by T.N.O. for gold mining interests in the Union of South Africa. The 2.8-million-gal./day unit operated at partial capacity for several years, but is now shut down.

Allied Chemical's Plastics Div. will start marketing polypropylene on Nov. 1 under the Plaskon trade name. Allied will not make the material initially, however; it's being produced to Allied's specifications by an unidentified company.

Add foams to polypropylene's list of big-customer prospects

It looks as though foams will provide another much-needed outlet for fast-building polypropylene capacity. Wire coating—a market already absorbing 120 million lb./yr. of polyethylene—is among the advanced development projects of such firms as Bell Laboratories and Hercules Powder.

Industry reports indicate that Bell's associate, Western Electric Co., Inc., will soon start production of a gage of wire insulated with polypropylene foam that will eliminate 5-10 million lb./yr. of polyethylene, at a saving of anywhere between $2 and $9 million/yr. However, Western Electric will not confirm this timetable, says any plans it may have for polypropylene foam are still a year away.

The simple charm of polypropylene foam in wire coating is that it does a better job at lower cost. The low dielectric constant of polyolefins—about 2.2—is further reduced by the inclusion of air with a dielectric of 1. Polypropylene foam containing as much as 40% air still retains considerable mechanical strength, whereas polyethylene foam becomes fragile and "cheesy," at those levels.

This combination of electrical properties and strength means that wire coatings of polypropylene foam can be 35-40% thinner than unfoamed polyolefins and still do the same job. In addition to raw-materials savings, thinner wire coatings benefit the customer, e.g., more wires will fit in a conduit.

According to Du Pont's John Tallman, in a recent paper before the AIChE, polyolefin foams are expected to grow from 2 million lb. produced in 1961, to 35 million in 1966. Of the 1966 total, 20 million lb. will be absorbed by wire coating.

Humble Oil & Refining Co. will fight inroads of natural gas in home heating on the Eastern seaboard with an oil-burner attachment that increases flame efficiency, cuts fuel bills by 20%. Conversion is also claimed to give quieter and cleaner operation.

Lake Placid conferees hear suggestions for hoisting profits

Alarmed that mounting costs and lower earnings are afflicting the chemical industry, several panels at the AIChE meeting in Lake Placid, N. Y., analyzed various aspects of the profit problem. Among the solutions offered:

• Shell Chemical's S. H. McAllister, commenting on plant capital investment costs, noted that the downward slope of the price-time curve for most chemicals dictates getting a plant built and running as soon as possible, in order to take advantage of higher prices. To do this, pilot plants should be bypassed whenever possible. The time gained, he said, is in many instances more valuable than the extra data obtained by piloting.

• John Powers of Pfizer International, Inc., stated that entry of England into the European Common Market means great investment potential for U. S. chemical firms. An integrated West European economy will present a market as large as the U. S.—ideal for manufacturers experienced in building large efficient plants.

But Powers noted with concern that present U. S. policy discourages investment in Europe—

For more efficient sulfations and sulfonations **99.5% available SO_3**

GENERAL CHEMICAL

SULFAN®

the stabilized sulfur trioxide that's backed by 10 years of application experience

General Chemical SULFAN offers you many significant advantages—in use, in service, in supply.

The unique form and properties of SULFAN—99.5% available SO_3 in easy-to-handle liquid form—enable you to step up operating efficiency, to run larger batch sizes, and to get more rapid through-put . . . often *double* in the same equipment. No spent acid disposal problems, either!

You also get the benefits of General's 10 years of experience with stabilized SO_3, for all types of application. Our technical service specialists can really show you where, when and how to cash in on SULFAN for *your* operation.

A further and not inconsiderable advantage you get with SULFAN is dependability of supply. As the only supplier of stabilized sulfur trioxide with multiple producing locations, General Chemical can provide better service . . . assurance that your schedules can be met!

Learn more about SULFAN now. A letter outlining your particular requirements will bring information of immediate practical value! Or mail coupon for free technical brochures.

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.

Mail coupon now for free technical brochures on SULFAN!

GENERAL CHEMICAL DIVISION
Allied Chemical Corporation
40 Rector Street, New York 6, N.Y.

Please send free copies of "Reactions of Sulfur Trioxide," and "Sulfan."

Name_____

Title_____

Company_____

Address_____

City_____ Zone_____

CE-101

State_____

theoretically to reduce the dollar outflow. This, however, is despite a recent survey of 20 U. S. firms, showing that $40 million invested in Western Europe has already returned $600 million to the U. S. in dividends, and export sales.

• Scientific Design's Ralph Landau contended that research and development departments have been too sheltered from economic realities. Noting that a few years ago $1 invested in research would result in $4-5 of new plant, while today's dollar leads to only $3 of new plant, Landau advocated closer scrutiny of the payout potential of research projects, rather than merely investing a fixed percentage of sales in research.

Among his other suggestions for increasing research profitability: encourage competition between separate research groups; cut down on free research done for customers; concentrate on research in a company's strong areas, and buy technology in other fields.

• American Cyanamid's T. P. Forbath stated that, in market development, changed conditions call for consumer orientation, rather than mere product promotion. The trick is to define some unfilled customer need—then to set about creating a product to satisfy that demand.

Process restores vitality to metal-contaminated catalysts

Atlantic Refining Co. is now erecting a unit at its Philadelphia refinery to decontaminate cracking catalysts via a new process. Results of the novel treatment were described at the recent AIChE meeting in Lake Placid—but the chemistry of the technique remains a secret.

Called Met-X, the process removes metal poisons without reducing catalyst area. This essentially makes the catalyst as good as new, in contrast to earlier acid-treating processes that successfully removed metals—but at the expense of catalyst performance.

In a typical commercial operation, with 0.2 lb. of fresh catalyst charged per barrel of cat cracker feed, rate of Met-X treating would be 2 lb. of catalyst per barrel of feed (5% of catalyst inventory). This would reduce the "coke-producing factor" (Atlantic's own correlation) of the equilibrium catalyst in the cracker from 1.8 to 1.2 (fresh catalyst is 1.0).

From a catalyst containing (in weight per cent) 0.18 Fe, 0.2 Na, 0.02 Ni, 0.03 V, Met-X produces the following analysis: 0.14 Fe, 0.08 Na, and less than 0.02 Ni and V. Since all the metals are not removed, it appears that the treatment selectively extracts only the active forms of the metals.

Extension of the process to handle extremely high metal-contamination loads, using reduced feed rate to the cracker, has also been demonstrated in Atlantic's pilot plant.

Crankcase device approved, but no progress on exhaust converters

It appears certain that the $0.5-1 billion market anticipated in California for exhaust smog-eliminators will go untapped for another year. Chances are good, however, that two crankcase blow-by devices will be approved by the end of this year (two are needed before the new anti-smog law takes effect).

One blow-by device, manufactured by the A. C. Spark Plug Div. of General Motors, already has received the required certification of the Motor Vehicle Pollution Control Board (MVPCB).

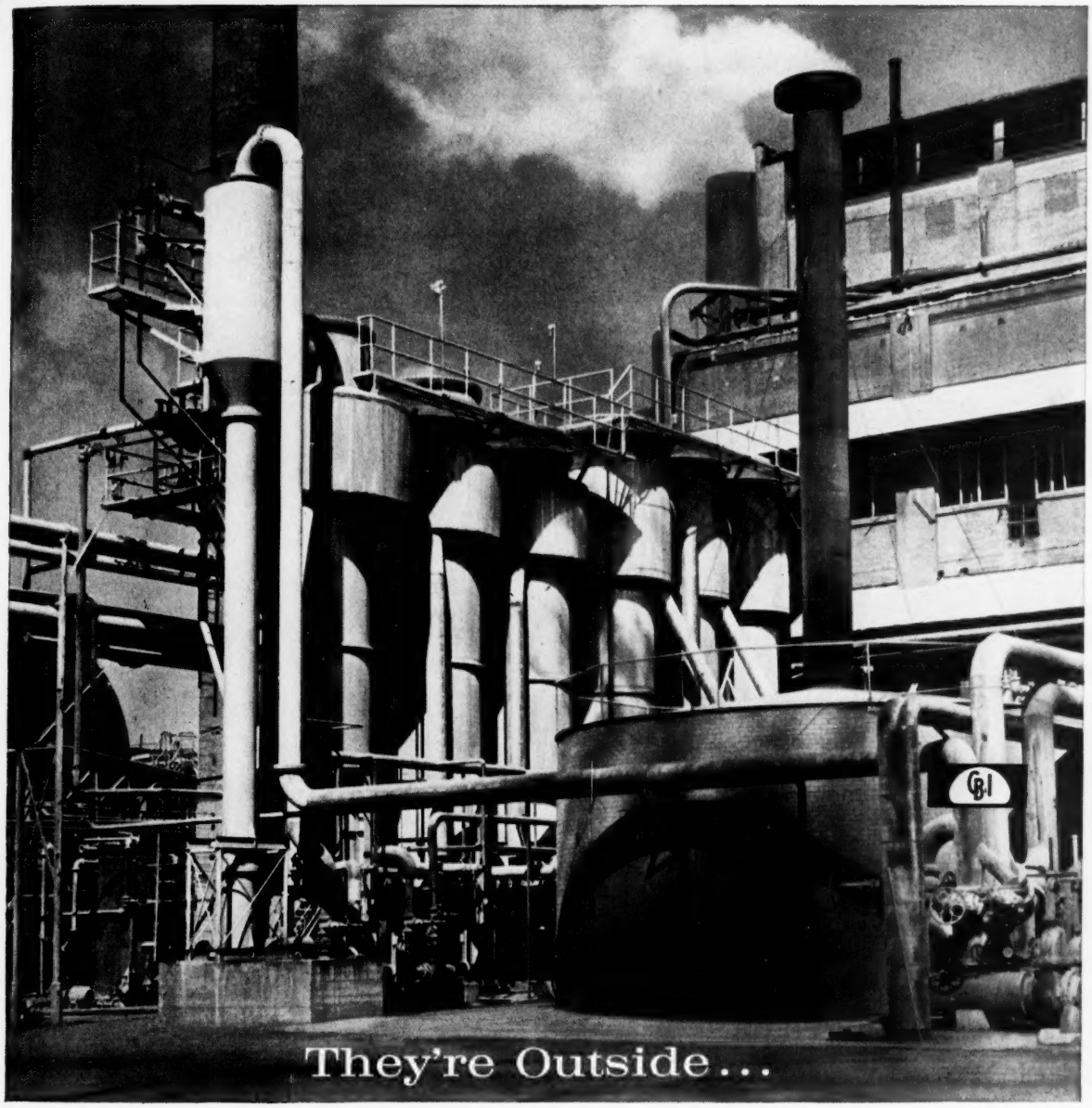
In the area of exhaust converters, eight companies still have applications under active consideration by MVPCB, but only Oxy-Catalyst's device has completed preliminary screening and moved into performance testing (*Chementator*, June 12, p. 90).

MVPCB has the personnel and facilities to do more testing, but trade sources indicate that some of the applicants are hesitant to submit their devices for performance tests until Oxy-Catalyst's converter is certified and they know the operating characteristics and price of the accepted unit. Some of these applicants also feel that their devices are not perfected sufficiently to meet the test criteria, and present entry would be premature.

Manufacturers that still have blow-by devices under consideration are Carter Carburetor Co., St. Louis; Alma Mfg. Co., Los Angeles; Rochester Products Div. of General Motors; and the Los Angeles County Air Pollution Control District.

The certified A.C. Spark Plug device has been installed on all new cars coming into California in 1961, at a cost of about $5; owners may have them removed, if they desire, until a second device is approved and law enforcement begins. Air Pollution experts agree that use of these blow-by devices will cut down smog-producing emanations by 25-30%.

For More Industry & Economic News . . . p. 94



GB-6110

Require Minimum Space...
Need No External Support...

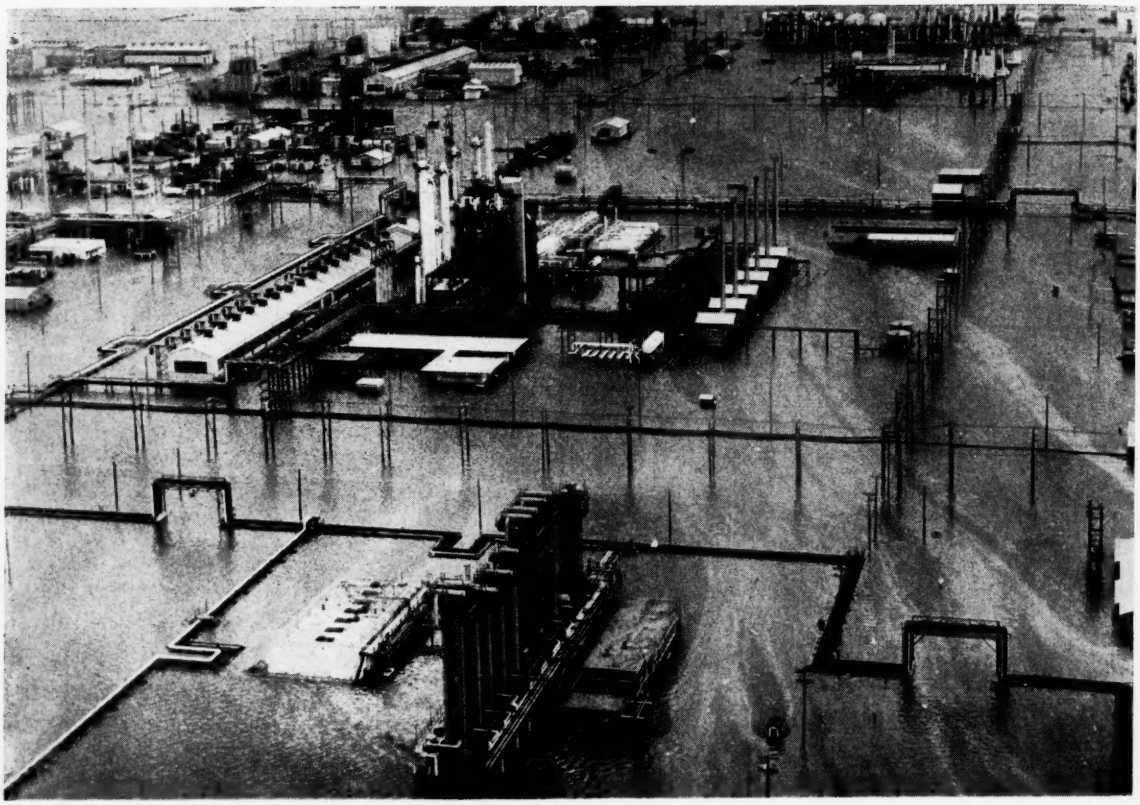
Installation of CB&I's sextuple effect evaporator at International Paper Company's Georgetown, South Carolina, mill resulted in the following performance:

More than 99.9% of the chemicals processed by this evaporator are recovered. Equally important are the operating economies of this highly-efficient evaporator system. Waste heat is collected at a low cost. The CB&I patented integral preheaters reduce steam requirements and improve the evaporation capacity. The patented entrainment separators for recovering process chemicals are most efficient.

Constructed with stainless steel and Hortonclad® stainless in areas subject to corrosion, and embodying CB&I's high standards of fabrication, this evaporator will operate efficiently for years with minimum maintenance costs.

This evaporator is one of many ways CB&I works with the pulp and paper industry in improving efficiency and increasing production. Chicago Bridge & Iron Company, 332 South Michigan Ave., Chicago 4, Illinois. Offices and subsidiaries throughout the world.

CB&I



Dow Chemical's plant at Freeport, Tex., sits under 4 ft. of water driven over 18-ft. levee at peak of hurricane Carla.

CHEMICAL PLANTS RIDE OUT GULF COAST HURRICANE AS GOOD PLANNING AVERTS MAJOR DISASTER

Here is a look at how some Texas chemical plants implemented their disaster plans—and some of the unforeseen problems resulting from hurricane Carla.

Any moral to be drawn from the chemical industry's experience with the recent Gulf Coast hurricane would be: planning pays off.

Hurricane Carla, which ripped into the Texas Coast on Sept. 11, did surprisingly little damage to petroleum refineries and chemical plants, considering that the storm was considered the most severe to hit Texas in this century. The absence of major damage can be attributed to two main factors: (1) the Weather Bureau kept close watch on the storm and gave plenty of advance warning; (2) chemical plants' disaster plans provided for orderly shutdown and buttoning-up procedures well before the hurricane struck.

Although hurricane gusts up to 173 mph. were recorded, industrial damage came mainly from water, not wind. The winds were high enough to set some plant designers to worrying about the allowances they had made for wind loadings, but there have been no reports of processing equipment being toppled.

Water, however, was a different problem. Many plants, especially in the Texas City area, suffered flooding that damaged motors, pumps and electronic controls. It was the rehabilitation of water-sodden electrical gear that proved the major problem for engineers returning to start up plants. In some cases, it was more than a week before all motors could be dried out and placed back in service.

▶ **Warned in Time**—Transmission of hurricane warning information is part of most Gulf Coast chemical plant mutual-aid systems, and at least one company—Dow Chemical—has its own radar installation for tracking big storms.

However, coverage of hurricane Carla by public radio and television was so complete and timely that the private warning systems were considerably behind the Weather

Bureau bulletins. One of those running behind: the radio network of plants along the Houston Ship Channel. The system will probably be analyzed later to try to speed up its alarm effectiveness.

▶**Preparing for the Worst**—Chemical plants had ample time to arrange for orderly shutdowns and evacuation of personnel.

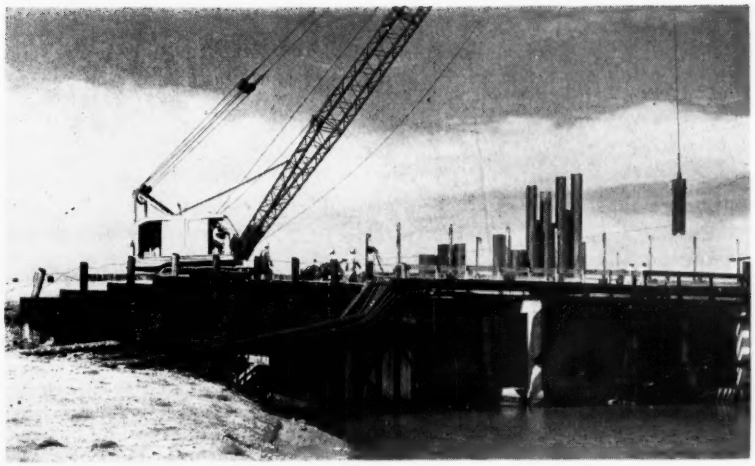
Typical of the shutdown operations all along the coast is the step-by-step procedure carried out by Amoco Chemicals Corp. at its Texas City plant:

- Two days before the storm hit, Amoco surveyed all storage tanks—feed, intermediate and finished products—to see if they held enough liquid so as not to break loose and float off during the hurricane.
- Charging of feedstocks was shut off to the processing units.
- Units were depressurized: fluids going to storage tanks or to waste-product furnaces. When possible, material was left in the units to add weight.
- Where it was necessary to prevent a vacuum, batch reactors and other units were pressurized with natural gas. Units that were cleared of material were also purged with natural gas.
- All units were then shut down in a blocked-out sequence.
- As the steam load was reduced by the unit-by-unit shutdown, steam boilers were turned off in sequence.
- Plant was then entirely deactivated by pulling the main electrical switch supplying power to the plant.

While the units were being shut down, a thorough policing operation was carried on to fasten down any loose objects that might be picked up in a high wind or water.

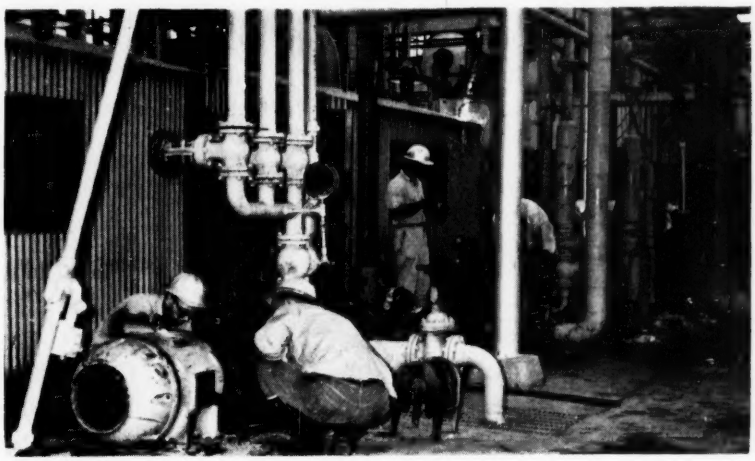
▶**Keeping in Touch**—Good communications is regarded as the most vital part of any disaster plan.

As part of the over-all mutual-aid system of plants along the Houston Ship Channel, Monsanto set up a communications center in a conference room in its engineering building. It contained several telephones for key personnel—with the same extension numbers as the men



Workers rush repair work on a sea water intake valve that failed under the onslaught of the storm and let water flow into the Dow plant.

Thousands of barrels, stockpiled by the Army at Texas City, broke loose, cluttering up plants and blocking roads when they came to rest.



Typical scene after the storm: engineers at Amoco Chemicals' plant ponder best method for rehabilitating water-soaked electric motor.

had on their normal office telephones. One line was a direct connection to Monsanto's headquarters in St. Louis, and at one time it was the only link between Texas City and the outside world.

The direct line was used several times to transmit Civil Defense information—first by relaying it to St. Louis, then rerouting it back to the distressed areas. It was used to request emergency power generators for Texas City from Ft. Sam Houston in San Antonio and later to request six amphibious carriers to bring in necessary shipments of food.

Personnel in the Monsanto plant were able to communicate with other plants via the mutual-aid radio network. Chemical engineer Norman Bach was credited with keeping three radio transmitters on the air constantly (except for a period when emergency generators failed). An Army reserve officer, Bach was in contact with Army authorities; among other things, he secured 500 cots and a complete field kitchen from the Army for the Red Cross.

▶ **The Aftermath**—Plant hardest hit by the hurricane was Dow Chemical's at Freeport, Tex., which had 4-5 ft. of water flood its plants A and B (*Chem. Eng.*, Oct. 2, p. 33). This flooding was caused by two separate breaches of sea walls guarding the Freeport plants.

In the Texas City area, flooding was also extensive. One plant superintendent estimated that 95% of his pumps and motors had been covered by water. Many of the plants were prepared for this, however, so the damage was minimized.

Union Carbide's Texas City plant, for example, has provision for protecting key synchronous motors by sandbagging, or by hoisting them out of their mounts and keeping them suspended out of danger. Smaller motors are protected with waterproof silicone grease. In most instances of slight fresh-water immersion, motors with silicone protection can be started up and dried out while running in place.

Carbide did have some serious sea-water immersion of motors that were down by the dock area. These were covered with 6-8 ft. of salt water and had to be removed, flushed free of salt and baked dry. By Sept. 19, Carbide reported that its Texas City plant was back in full operation and meeting regular shipping schedules.

▶ **The People Problem**—For some of the companies, the storm created unusual personnel problems.

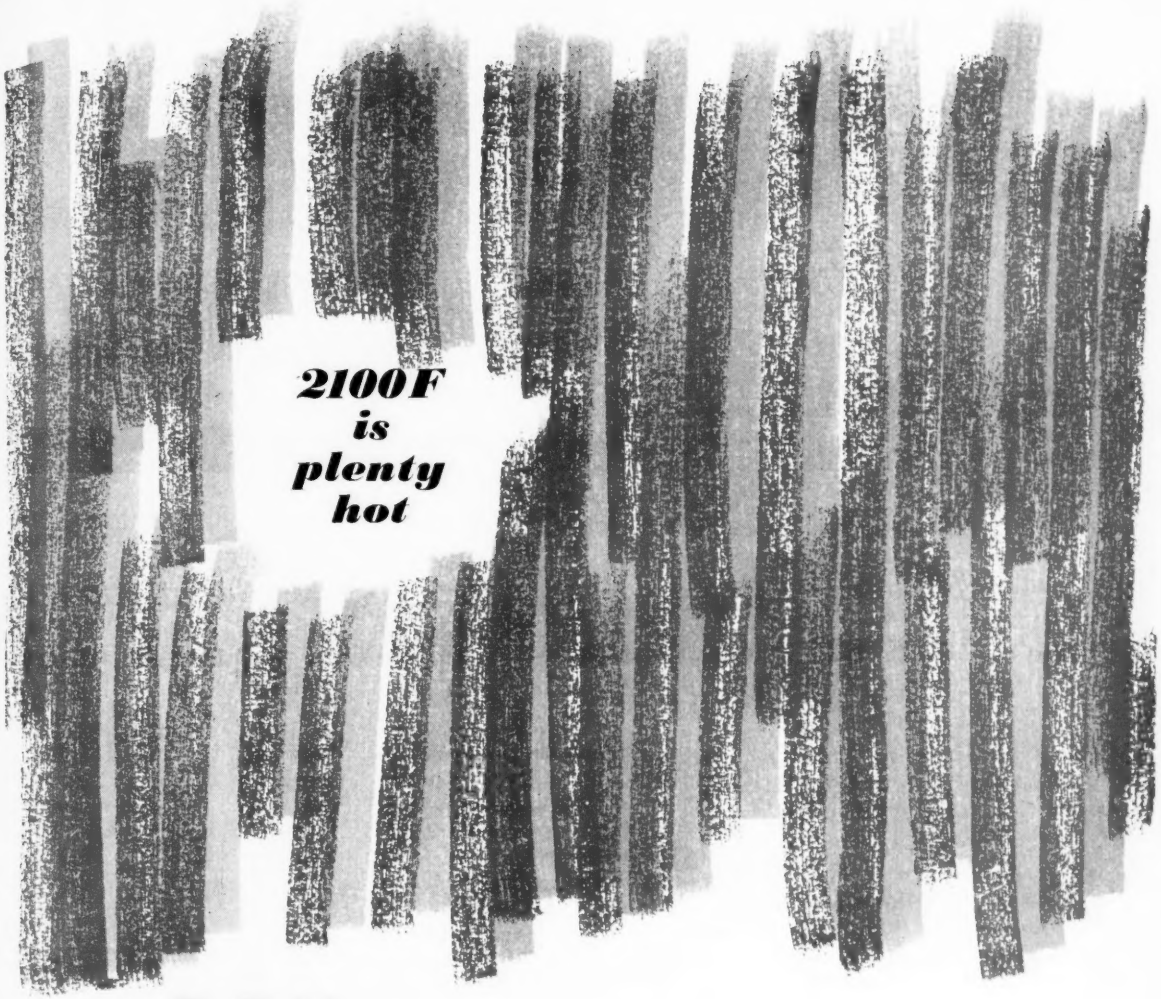
Monsanto Chemical, for example, kept emergency crews on hand at Texas City. To do this, it housed not only the workers but also their families. These were asked, wherever possible, to bring their own bedding and food to the plant, but Monsanto also kept a free cafeteria open throughout the hurricane. The company also worked with Civil Defense aiding other storm victims.

A special problem was created by children housed in the plant. One baby had to be provided with a special type of food via amphibious Army vehicle, after conventional trucks could no longer make it through the flood waters.

After the storm, all employees needing help to clean up their homes—and most of them did—were given kits containing a large bucket, mop, hose, detergent and other cleaning material.—RAL

Sun-powered generator can run irrigation pumps

Drawing upon recent advances in thermoelectricity, engineers at Westinghouse Electric Corp. have devised a solar electric generator that could find wide use in underdeveloped areas (see story on p. 104). The prototype unit, shown above, furnishes 50 watts of power by focusing the sun's rays on a thermoelectric unit. A larger 200-w. version, now under development, can furnish enough power to pump water from a depth of 20 ft. to irrigate four acres of land with 24 in. of water per year, assuming 250 days of sunshine annually.



new B-E-H

#1 plus *insulating cement can take it*

Heat protection hits a new high in B-E-H #1 Plus Insulating Cement for uneven surfaces, fittings, pipes and valves. Now effective up to 2100 F . . . B-E-H #1 Plus provides a comfortable margin of protection that insures excellent thermal efficiency even on installations not normally subject to super-high temperatures.

Plus in performance – the more resilient fibers and special binder developed by B-E-H research produce a whiter finish that looks better – handles easier – sets smoother.

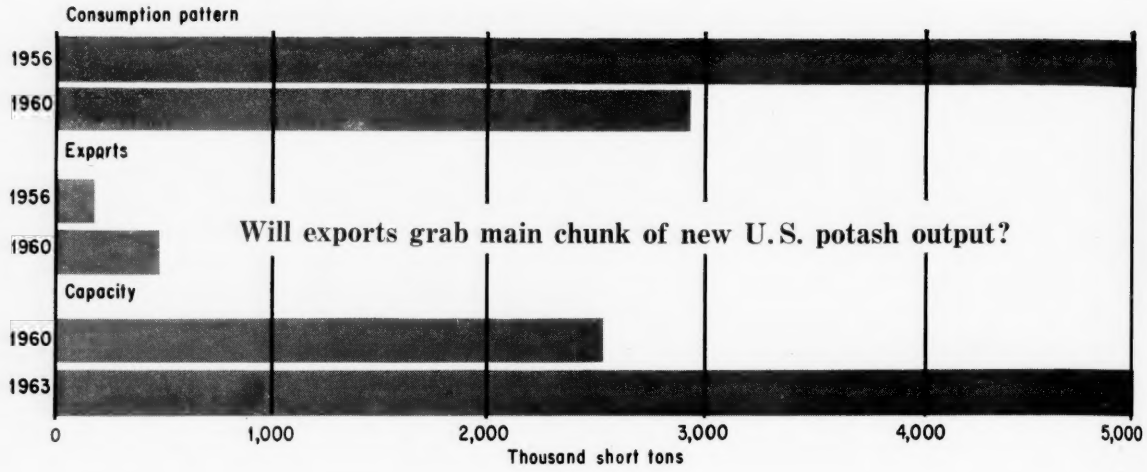
Plus economy – priced dead-level with other high-quality insulating cements. B-E-H #1 Plus provides an additional 300 F of effective insulation, a whiter, smoother finish, and easier mixing and handling. It pays to specify B-E-H #1 Plus for every job.

For complete technical data and name of your nearest qualified Baldwin-Ehret-Hill distributor-contractor, write: Baldwin-Ehret-Hill, Inc., Room 101 , Trenton 2, N. J.

B E H
BALDWIN EHRET HILL

BALDWIN-EHRET-HILL, INC.

Manufacturers of a complete line of pipe, block, felt and blanket insulation for temperatures from near absolute Zero to 2100 F.



PRODUCERS STEP UP CAPACITY TO MEET POTASH PUSH

A rare pleasure in today's overcapacity-ridden process industries . . . potash demand exceeds supplies. So, producers are getting set to make up for five static years.

A sharp increase in facilities for potash production has put the material squarely in the spotlight.

As with the other plant foods—nitrogen and phosphorus—potash use is riding uphill on such sure steeds as population growth, the rise of underdeveloped countries and, particularly in the U. S.—the trend to high-analysis fertilizers. The yearly rise, 350,000-650,000 tons of K_2O, compares to the output of a major mining operation.

In sharp contrast to nitrogen and phosphorus, which have had some bouts with overcapacity, potash production has not kept pace with demand. In the U. S.—a major producer among the half-dozen or so countries with commercial potash deposits—there has been no significant increase in capacity since 1957.

At present, most domestic potash comes from the area around Carlsbad, N.M. The higher grades of deposits here, averaging 20-25% potash, are approaching exhaustion. (The lower-grade deposits should have a life of about 25 yr.) And European reserves are diminishing so that exporting countries such as France, and East and West Germany, may turn to importing to meet their requirements. If no new fields were to open up, potash would remain in rather tight supply.

▶ **Rich Promises Up North**—Since the mid-fifties, however, promises of rich, new supplies from Canada have kept the industry in a state of suspended animation. During these years, International Minerals & Chemical Corp. (IMC) and Potash Co. of America (PCA) have been working toward mining Saskatchewan deposits that run up to 30% potash. According to some estimates, these deposits can produce twice the Carlsbad rate.

Chief stumbling block has been the Blairmore formation, a massive underground swamp about midway between the surface and the 3,500-ft.-deep potash deposits. (Carlsbad deposits are only 1,000 ft. deep.) By freezing the quicksand and sinking a heavy concrete shaft, PCA actually got production started in 1959, but leaking soon put a halt to it.

However, a joint venture of Armour & Co. and Pittsburgh Plate Glass Co. will attempt to take advantage of the water in the Blairmore stratum by using it for solution mining (*Chem. Eng.* May 15, p. 72).

In addition, U.S. Borax & Chemical Corp. and Homestake Mining Co. have just joined to complete studies on possible large-scale potash production in Saskatchewan. U.S. Borax has been investigating permits held there since 1957, and one or more additional associates may also be invited to participate.

PCA's installation, now undergoing a grouting program to stop the leakage, aims at 320,000-tons/yr. output. And IMC expects to produce over 1 million tons/yr. at Saskatchewan, aims at starting late in 1962. Its investment will come to over $40 million.

▶ **And Out West**—Early this year, Texas Gulf Sulphur thickened the potash plot by deciding to diversify. The company acquired a potash reserve near Moab, Utah, said to be as rich as the Saskatchewan deposits. Construction was begun on a $30-million mine and plant, to have an annual capacity exceeding 1 million tons.

These facilities, which should be

In every operation that calls for QUICK, TIGHT CONNECTIONS

Install EVER-TITE Couplings

You get tight, safe connections that *prevent leakage and losses* when you install Ever-Tite Couplings—because in every Ever-Tite, tightness is pre-determined and built in by compression on a resilient gasket.*

And you make faster changes—reduce down time—because Ever-Tites are *quick* to connect: you just slip the coupler over the adapter and close the handles.

This speed and flexibility is an important time saver in making connections between stationary equipment and portable equipment, and for interchanging couplings in experimental set-ups.

It will pay you to install Ever-Tites on all equipment that requires quick connections: loading equipment for tank cars, trucks, etc. . . . steam, air and water lines . . . pumps and other machinery . . . blending equipment . . . container filling devices . . . fire hydrants . . . acid handling equipment at storage and transfer locations.

Available in Brass, Malleable, Stainless, Aluminum, Monel, or other materials for corrosion resistance under any atmospheric or operational conditions. In sizes, high and low temperatures, and pressure ratings to meet *your* needs, produced to meet ASA ratings—specify size and pressure.

Write today for illustrated catalog No. C-11.

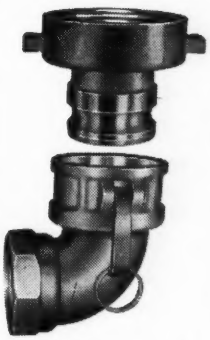
*Ever-Tite gaskets are regularly supplied of Buna N composition. Also available in Neoprene, Pure Gum, Butyl, Silicone, Teflon, Thiokol, or any other material to meet specifications.

EVER-TITE COUPLING CO. INC.
254 West 54th Street, New York 19, N. Y.

EVER-TITE
Standard Adapter
and Coupler

EVER-TITE
Shank Hose Coupling

EVER-TITE
Adapter
and Coupler



EVER-TITE
Adapter and Coupler
for Tank Car Unloading

Potash consumption is growing faster abroad

(Thousand short tons)

	1955–56	1959–60
Europe	3,593	4,928
North America	1,994	2,420
Asia	468	704
U.S.S.R.	.....	865
South America	27	100
Africa	43	90
Oceania	49	70
TOTAL	6,700	9,200

Courtesy Food and Agriculture Organization of the U. N.

completed by the end of 1962, will make TGS the largest strictly domestic potash producer. None of the expensive water problems that have plagued Canadian mining efforts should crop up at Moab, which is arid country.

Adding to the activity in Utah: Continental Oil, announcing that it will drill for potash about 30 miles from the TGS mine; and Bonneville, Ltd. (whose potash comes from evaporating brines rather than mining), with news of expansion at Wendover, Utah.

American Potash & Chemical, also processing by evaporating brines, is expanding at Trona, Calif. And in New Mexico, Southwest Potash Corp. (SPC), a division of American Metal Climax, is spending $3 million to expand its facilities at Carlsbad.

SPC's expansion is aimed at supplying captive needs of the company's new potassium nitrate plant. Its $7-million plant in Vicksburg, Miss., due on stream this month, will be the first aimed at producing KNO_3 for volume fertilizer markets. (Stauffer produces KNO_3 for chemical use.) Product will be 14% nitrogen, 44% potash. Its uses: crops believed damaged by Cl ions.

▶ **Price Echo**—Promises, then delays, of big Canadian supplies over the past few years have been reflected in prices. In the 1957-58 season, potash was priced at 34¢/lb. Then as PCA showed signs of starting Canadian production, price dropped to 30¢/lb. and stayed there through the 1958-59 and 1959-60 seasons. However, when the Canadian supplies did not materialize and the world supply-demand balance tightened, price rose to 33¢/lb. in the 1960-61 season, went up to 35¢ July 1 when the 1961-62 season began.

▶ **Exports**—North American exports climbed from 226,000 tons in 1956 to about 420,000 last year. Reports are that producers were exporting all the potash they could spare during 1960. There was some reversal this year, however, when huge producer inventories piled up in the U. S., due to a late planting season caused by bad weather this spring; and many farmers—particularly in the Midwest—cut down acreage by cooperating with the government's feed-grain program.

Figures just released by the American Potash Institute for the 1960-61 fertilizer year show deliveries of potash for agricultural purposes in the U. S., Canada, Cuba and Puerto Rico, by eight American producers and importers, totaled 3.6 million tons of salts containing an equivalent of 2.1 million tons K_2O. This was a decrease of over 15% in salts and 16% in K_2O from the preceding fertilizer year. Exports to other countries were 418,000 tons K_2O, an increase of nearly 10%.

Japan, in particular, is expected to take major quantities of North American potash. Producing none internally, Japan's consumption has grown from 425,000 to 577,000 tons between 1956 and 1960, with North America supplying most of it. In its latest annual report, International Minerals & Chemical Corp. predicts that Japan will be taking 54% of North American output within a few years.

World consumption of potash fertilizers has increased about 38% since 1956—from 6.7 million short tons K_2O in 1955 to 9.2 million tons in the 1959-60 season.* Domestic consumption has been growing more slowly: 2.3 million to 2.9 million tons between 1956 and 1960. This is a trend that is supposed to continue.

▶ **Crystal Ball**—For 1980, the U. S. Bureau of Mines anticipates a world potash demand (90-95% for fertilizers) of 16 million tons K_2O. One industry observer foresees 6% annual growth rate in the U. S. over the next decade and 6-10% abroad. The Tennessee Valley Authority puts 1975 potash fertilizer requirements in the U. S. at 2.8 million tons, compared with 2.1 million in 1960.—FA

* "Production Yearbook—1960," Food & Agriculture Organization, Rome.

North American potash capacity to double in near future

(Thousand tons/yr. K_2O)

Producers & Location	Existing	Abuilding
American Potash & Chemical Corp.		
Trona, Calif.	225	
Bonneville, Ltd.		
Wendover, Utah	50	
Duval Sulphur and Potash Co.		
Carlsbad, N. M.	250	
International Minerals & Chemical Corp.		
Carlsbad, N. M.	375	
Saskatchewan, Canada		1,200
National Potash		
Carlsbad, N. M.	250	
Potash Co. of America		
Carlsbad, N. M.	575	
Saskatchewan, Canada		320
Southwest Potash Corp.		
Carlsbad, N. M.	250	
Texas Gulf Sulphur		
Moab, Utah		1,000+
U. S. Borax & Chemical Corp.		
Carlsbad, N. M.	540	

Data courtesy American Potash Institute.

Improve your Engineering I.Q.*

* INCOME QUOTIENT

Buyer-Seller "Alliance" Important To Engineers; Orders Are Born of Confidence

It is oftentimes surprising to the engineer that in the course of his career, if it is to be a rewarding one, he will be required to develop talents of both selling and buying. To put it simply: *either you have sold or you have been sold every time you talk to someone.* If you haven't closed your mind, you will often be sold. If you are competent to do so, you will just as often sell someone else.

Selling and buying processing equipment is a highly developed field, but essentially it consists of buying and selling ideas. As you advance into supervisory, management and executive functions, you will be called on to exhibit greater buyer-seller abilities.

Most buying in industry involves from three to six individuals. Although the purchasing agent will be a key factor in all purchasing, almost all purchases in technical fields require the technical assistance of someone outside the purchasing department.

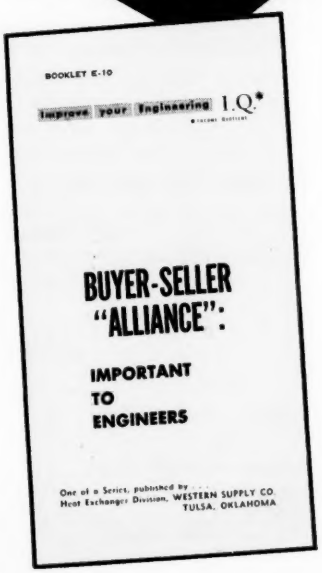
An industrial buyer, whether he is a purchasing agent or an engineer, is *human*, and is responsive to the same human values that you are when you buy a car or a suit of clothes. The industrial purchaser, though, is keenly aware of the plant and organization for which he buys. He is conversant with the product needed, and with its ultimate use.

The purchaser's objective is to procure the right equipment or material, of the right quality, in the right quantity, at the right time, from the right source, and at the right price. In accomplishing this he actually becomes a "salesman-selling-a-salesman."

In modern business the purchasing department should be a profit-making department. A four per cent savings in purchase costs, for instance, might be equal in profits to a 20 per cent increase in sales volume. Considering that the average industrial firm spends about 50 to 60 cents of each sales dollar for purchases, purchasing savings can easily represent the margin of profit.

In one large steel company, costs of products and services bought exceeds four million dollars for each working day. The variety of products bought is in the tens of thousands and these are purchased from nearly 50,000 suppliers.

WRITE FOR YOUR COPY TODAY

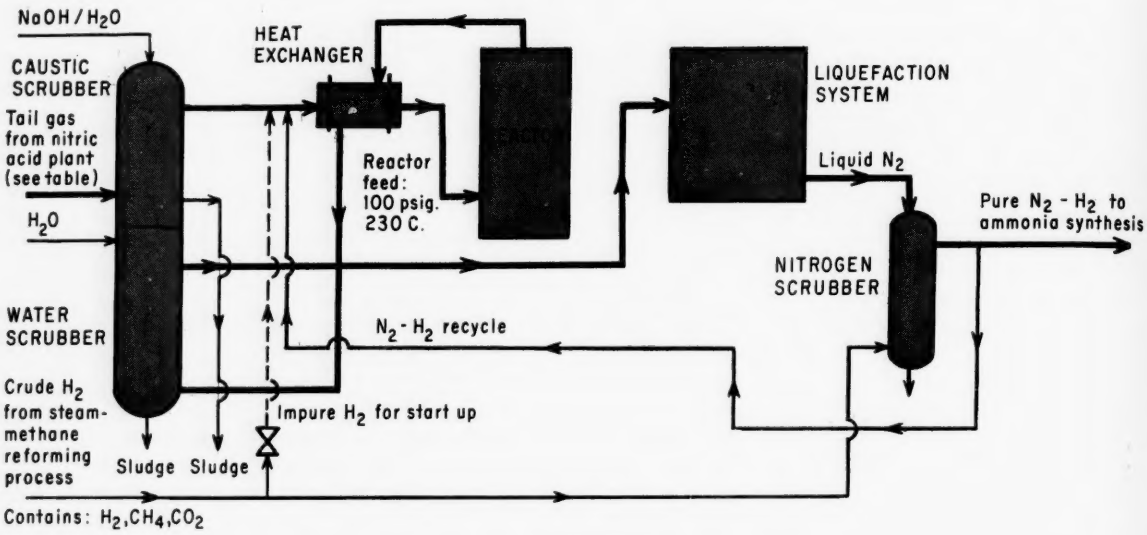

BOOKLET E-10
Improve your Engineering I.Q.*
BUYER-SELLER "ALLIANCE":
IMPORTANT TO ENGINEERS
One of a Series, published by Heat Exchanger Division, WESTERN SUPPLY CO. TULSA, OKLAHOMA

The foregoing paragraphs are taken from one of Western's "professional development" booklets, and reflect our own philosophy on the subject.

Understanding both sides of the coin — the problems of the buyer as well as the responsibilities of the seller —has long been required of all Western sales and engineering personnel. It has contributed greatly to the compatible relationships Western enjoys throughout the petroleum and chemical industries.

Your invitation to discuss heat exchanger problems with your purchasing and engineering departments would be welcome . . . as will your request for your copy of "Buyer-Seller 'Alliance' Important to Engineers."

WESTERN
HEAT EXCHANGERS
WESTERN SUPPLY COMPANY
P.O. Box 1888 – Tulsa, Oklahoma



PROCESS WRINGS PURE NITROGEN FROM NITRIC FUMES

Catalytic purification does double duty: recovers pure nitrogen from nitric acid plant tail gas, cures acute air pollution problems.

The truly successful design of an air-pollution control system usually means one thing — recovering enough valuable chemicals to pay for it.

That's what Du Pont has done at its nitric acid plant in Gibbstown, N. J. Here, the company operates a recovery unit that, according to its designers, is the only installation in which the entire nitrogen needs of an ammonia plant are satisfied by catalytic purification of nitric acid tail gas.

▶**Dream Fulfilled** — Engineers have long sought an economical method for recovering pure nitrogen from the tail gases of nitric acid plants. Even though such gas streams contain little besides N_2 (2-4% impurities), reclamation efforts have been largely unsuccessful, due to the difficulty of removing oxygen and oxygen compounds without introducing a variety of equally detrimental contaminants. Now, however, the problem has yielded to the combined engineering talents of Du Pont and Engelhard Industries, Inc. (Newark, N. J.).

In principle, their purification process is a simple one: remove oxygen and oxides of nitrogen by passing a mixture of hydrogen and tail gas over a catalyst at moderate temperatures, then scrub out any newly formed contaminants.

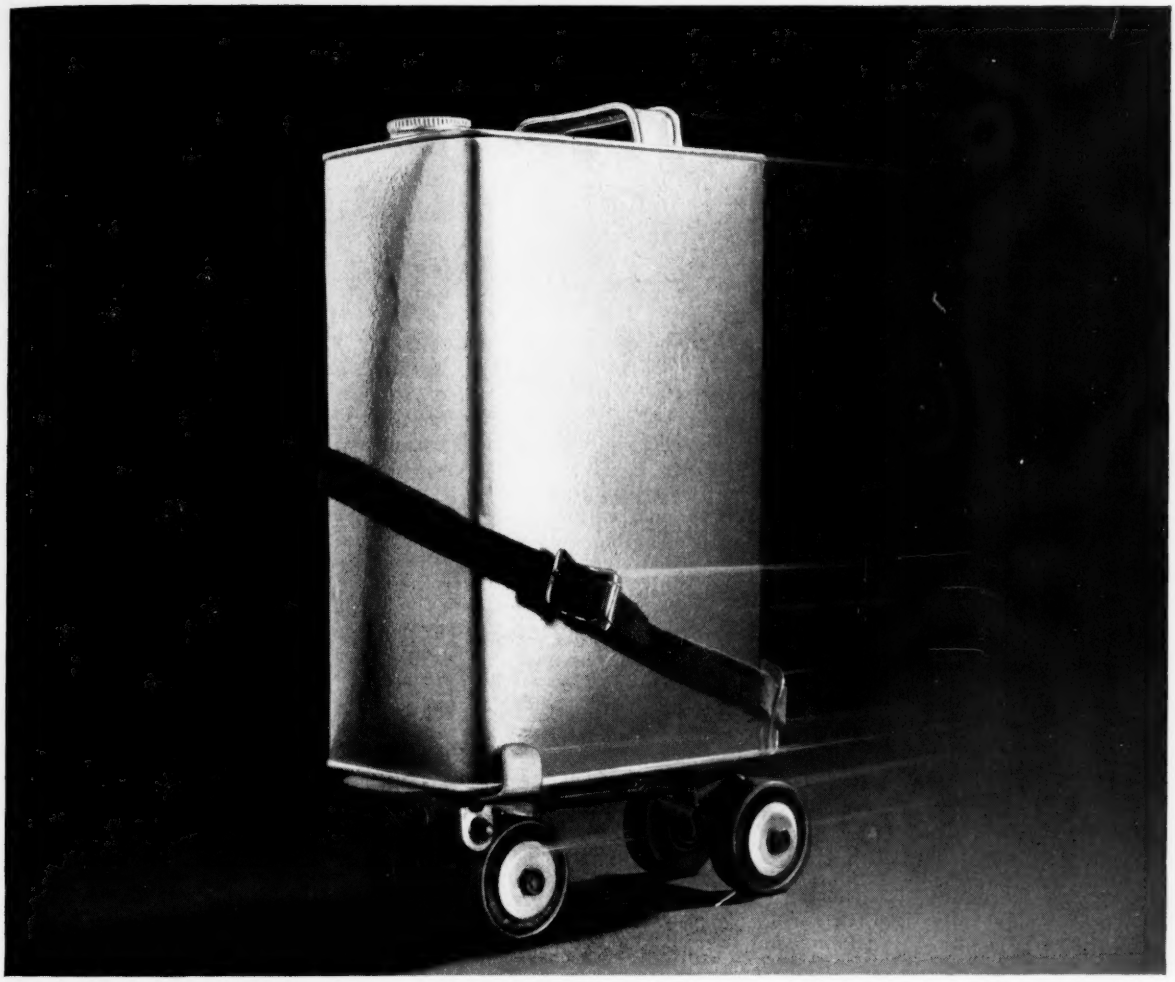
While designing the plant, however, Du Pont and Engelhard engineers found themselves faced with a doubly complex purity problem. Not only did the total oxygen content have to be lowered to less than 10 ppm., but also impurities in the reducing hydrogen had to be prevented from poisoning the product stream. Using a combination of separation techniques and catalyst know-how, designers came up with:

- A palladium catalyst to reduce the oxygen content. Besides dropping the nitrous oxide to a very low level, palladium is extremely effective in removing nitric oxide and nitrogen dioxide by hydrogen reduction.
- A combination of scrubbing and liquefaction procedures for removal of carbon compounds intro-

Stream composition charts impurity removal

	N_2O	NO NO_2	CO_2	O_2	NH_3	H_2	Ar	N_2
Entering tail gas	0.2	0.5	0.03	1.5–2	0	0	1	balance
After caustic scrubber	0.2	0.04	0.003	1.5–2	0	0	1	balance
After reactor	<0.0001	<0.0001	<0.003	<0.0003	0.03	1–2	1	balance
After water scrubber	<0.0001	<0.0001	<0.0005	<0.0003	<0.0003	1–2	1	balance

Typical results at space velocity of 25,000 std. cu. ft./hr./cu. ft. (expressed as %)



NOW MORE MILES TO THE GALLON OF GLYCOL!

Sodium Borohydride Treatments Stretch The Useful Life Of Glycols, Cut Your Costs!

This is an economy angle that's important to consider. Sodium borohydride gives important new "life" to glycols and polyglycols that are contaminated with trace carbonyl impurities . . . quickly, without any complicated reprocessing. Just add small amounts of sodium borohydride powder — or liquid solution (SWS). Within a short time, in some cases less than an hour, most of the unwanted carbonyl is reduced to the alcohol*, like this:

$$NaBH_4 + 4RCHO \xrightarrow{2H_2O} NaBO_2 + 4RCH_2OH$$

If you manufacture glycols, it will pay you to improve the purity of your product by adding sodium borohydride directly to the process stream — or, by using sodium borohydride pellets for fixed bed purification. Doing it either way will give you the purity you want — without adding any significant cost to your overall process!

JUST PUBLISHED — TECHNICAL BULLETIN 509

To get your copy — and technical service, if you wish — write, wire or call today.

*Patent #2683721 — owned by Metal Hydrides Incorporated

PIONEERS IN HYDRIDE CHEMISTRY

Metal Hydrides Incorporated

312 CONGRESS STREET, BEVERLY, MASSACHUSETTS

duced as hydrogen impurities. At startup, impure hydrogen is used as a reducing agent. Then, after liquid nitrogen has become available, the hydrogen is purified by a liquid nitrogen wash.

▶ **Process Steps**—Hydrogen, in 10-20% excess over the total oxygen, is mixed with tail gas, from which CO_2 and most of the NO and NO_2 have been scrubbed (flowsheet p. 102). The mixture is preheated and passed through the catalyst (230 C., 100 psig.), which removes NO, NO_2 and oxygen—leaving excess hydrogen to be recovered in subsequent ammonia synthesis. Reacted gas is then scrubbed for removal of ammonia formed by NO-NO_2 reduction and of the CO_2 from impure hydrogen used in start-up.

Now a mixture of pure hydrogen and nitrogen, the gas is finally cooled, dried, refrigerated and partially or totally liquefied. In the liquid-nitrogen scrubbing step, CO and methane are removed from the hydrogen-nitrogen mixture.

Although Du Pont and Engelhard engineers are quite pleased with their design efforts, they are quick to point out that a similar plant might be an economic impossibility under different circumstances. Such a process is only suited for locales where air-pollution control is required, and natural gas prices are high or hydrogen is cheap.—CRB

SOLAR ENERGY SPARKS A NEW HOPE FOR UNDERDEVELOPED AREAS

New and cheaper materials are the key to the harnessing of solar energy for power generation. Chemical syntheses in solar furnaces are also under study.

At the Conference on New Sources of Energy recently held in Rome under the auspices of the United Nations, more than 500 international experts looked into new ways of exploiting the energy of the sun, wind and natural steam. By far the most promising features of the meeting were the production of electricity from solar energy (by solar cells, fuel cells, thermoelectric and thermionic converters), and the production of intense light for photochemical synthesis by a solar furnace.

▶ **Converters**—Although most of the projects in this area are still in the research stage, advances over the past ten years have been significant. Direct power production by focusing sunlight on a target (i.e. a thermocouple) at 500 C. with a 5% conversion has become a reality during the last five years. But there are still many unresolved problems, such as heat losses by conductivity, acidification and oxidation at high temperatures, and insulation of cold and hot points.

Kurt Katz of Westinghouse Electric Corp. presented an analysis of the better performing semiconductors (cuprous oxides, selenium and lead sulfide, germanium telluride, bismuth and lead telluride) and considered the design features and economic parameters of a working thermoelectric system for mechanical power generation. According to Katz, who feels very confident about the attractiveness of solar systems, materials are the key to high energy conversion and longevity of thermocouples, because the efficiency of a thermoelectric converter is the product of the Carnot and material's efficiency.

In this respect, one disappointing bit of news in Rome was announced by Russian professor V. H. Baum, of the Krzhizhanovsky Power Institute: he reported that a gadolinium-selenium thermoelectric converter, which promised efficiencies as high as 55%, had not given satisfactory laboratory results.

Thermionic converters were considered with mixed feelings and diverging opinions. Although these converters could solve most problems inherent in thermocouples (because the sunlight target is a vacuum tube acting as heat conductor), they need higher temperatures on the order of 1,500 C., and perfect focusing collectors.

M.I.T.'s professor G. Hatsopoulos feels that thermionic generators could be built with an over-all efficiency of 17%. But the technique of making these converters is similar to that of high-vacuum discharge tubes, which are more expensive than mechanical moving parts. V. C. Wilson of General Electric Co. believes that a thermionic system could be built with an over-all efficiency of 9.5% and would be too expensive for practical purposes.

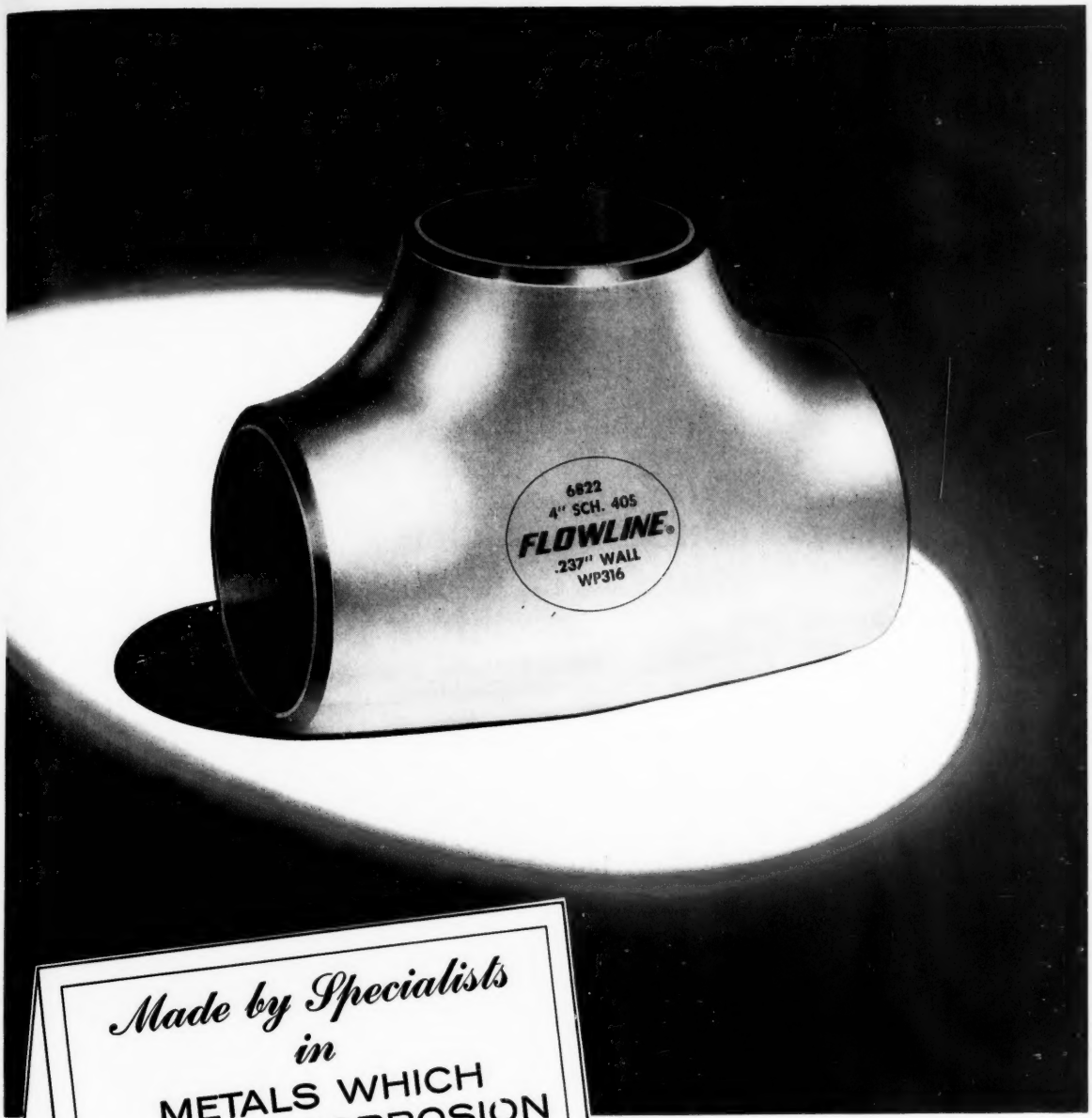
▶ **Solar Cells**—Also covered in the meeting, solar cells can convert sunlight directly into electricity upon irradiation of a photovoltaic layer. Silicon cells with a 10% efficiency have already been used successfully in space satellites, transistor radios, wireless telephone systems. But they are still too expensive.

According to L. E. Ravich of Itek Corp., Lexington, Mass., a 1-kw. power supply using silicon solar cells would cost from $250,000 to $1,000,000 and would weigh between 200 and 400 lb. It would be ludicrous to suggest such systems for power generation in underdeveloped areas.

Ravich and other experts agreed that cheaper solar cells could be made from polycrystalline thin-films rather than single-crystal cells. Although its 6% efficiency is lower than silicon's, cadmium sulfide seems to be the most likely material for the photovoltaic layers.

▶ **Solar Furnaces**—Large solar furnaces have already been used in the semi-industrial processing of minerals (in France, zirconium refining has been conducted in a solar furnace), but their greatest future lies in the industrial application of photochemical synthesis.

Usually considered to be a heat source, the solar furnace is more accurately a heat conductor. It is also a source of concentrated light; and R. J. Marcus and H. C. Wohlers of Stanford Research Institute have used it with liquid selective absorbers. (The difference between black body absorbers and selective absorbers is the temperature they develop—as high as 3,200 C. for



Made by Specialists in
METALS WHICH MASTER CORROSION

STAINLESS STEELS • ALUMINUM
MONEL • NICKEL

SIZES ½" THROUGH 24"
SCHEDULES 5S THROUGH XX HEAVY

FLOWLINE®
WELDING FITTINGS

Specialization pays off in stainless welding fitting quality. It makes possible use of production methods which put the metal in the best condition for corrosion resistance. We are the industry's only specialist in corrosion-resistant welding fittings — and have had more stainless piping experience than any other fittings manufacturer — since 1927.

FLOWLINE fittings are made to specifications which exceed the requirements of applicable A.S.T.M., A.S.A., and M.S.S. codes. Elbows, returns, stub ends, tees, reducers, caps, crosses, and 45° laterals are available from stock through leading distributors. Special fittings and flanges can also be supplied.

Write for Bulletin 416.

FLOWLINE CORP.
World's Largest Manufacturer of Stainless Welding Fittings
NEW CASTLE, PENNSYLVANIA • OLiver 4-5541

DENVER 4, 1321 Bannock Bldg.
KEystone 4-6143 —TWX, DN 372
HOUSTON 36, 5510 Edith St.
MAdison 3-6422
LOS ANGELES 22, 4781 East Third St.
ANgeles 8-3676—TWX, LA 1427
NEW YORK 7, 233 Broadway
WOrth 2-6669—TWX, NY 1-208
TULSA, Box 3325
TEmple 5-7575—TWX, TU 1234

F-2 **COST NO MORE THAN ORDINARY FITTINGS**

the black body, as low as −10 C. for liquid selective absorbers.) According to the two researchers, the solar furnace lends itself to continuous photochemical processes: reactants can be pumped quickly through the highly concentrated light at the focus of the furnace, where the reaction can be controlled by the residence time.

This technique has already been successful in the photochlorination of benzene to give benzene hexachloride; photosynthesized oxidation of xylene to give various phthalic acids; formation of cyclohexanone oxime (nylon-6) from cyclohexane photosynthesized by nitrosyl chloride; photopolymerization of iodobenzene to form biphenyl and higher polymers; and the perchlorination of benzene to form compounds containing more than six chlorines. Unfortunately, no work has been done on the economics of photochemical syntheses.

NEW UNITS BLEACH DENSER PULP

More efficient use of H_2O_2 bleach is obtained in two plants that use improved dewartering equipment to furnish a high-density pulp bleach-stock.

Two U. S. pulp mills are now successfully bleaching groundwood pulp on a commercial scale, at densities of 25% and higher, using hydrogen peroxide as the active bleaching agent.

This economical use of hydrogen peroxide is made possible through high-density pulp that allows more-efficient use of the bleaching liquor. And high-density pulp, in turn, is made possible by new machinery that achieves more-effective pulp dewatering.

At Deferiet, N.Y., St. Regis Paper Co. has been successfully bleaching groundwood pulp at a consistency of 25% A.D. (air dry) for the past ten months in a 120-ton/day single-stage bleaching plant. Bleaching solutions of 1% and 2% hydrogen peroxide have consistently yielded brightness levels of 70 and 75, respectively, from unbleached pulp fed into the system at a brightness level of 60.

At Shawmut, Me., Keyes Fibre Co. has been obtaining substantial brightness gains on groundwood pulps processed at consistencies of 30 to 40% A.D., using the Becco cold-steep procedure. The single-stage operation handles 90 ton/day, uses hydrogen peroxide bleach.

Research conducted in the early 1950's by St. Regis and Becco Chemical Div. of FMC Corp. established that the existing design of screw presses was not satisfactory for dewatering pulp to such high density. FMC's canning machinery division has since designed a press especially to dewater pulp, which draws on the design of an FMC screw press used in the food processing industry. This press is used in the new St. Regis unit at Deferiet.

Each press consists of a tapered spindle surrounded by an ascending thread with interrupted flights, mounted inside a cylindrical screen frame. As the spindle rotates, the pitch of the spiral screw carries the pulp upward through an increasingly smaller gap between the spindle and the screen. The amount of compression exerted on the pulp gradually increases as the material rises in the press, so that it reaches the discharge orifice at the top of the press at a consistency of 30% or higher.

A series of stationary horizontal breaker bars that project radially into the pressing space from the inner surface of the pressing cylinder prevent the pulp from merely rotating with the screw. The outer pressure cone, which surrounds the spindle, rotates with it. This prevents the rolling action between the pulp fibers, which would otherwise form hard bundles or knots.

At the groundwood pulp mill of Keyes Fibre Co., stock that has been screened and cleaned is thickened to a consistency of 13% A.D. in an Oliver thickener. This is then broken up on a repulper conveyor, which feeds into a screw-conveyor that supplies two disk presses. These operations raise the consistency of the pulp to between 30 and 40% A.D.

More Chemicals Producers Close in on Consumers

Already part of a growing caravan of chemical companies marketing directly to the public, Dow Chemical Co. intends to move still closer in 1962. According to President Leland Doan at a recent stockholder meeting:

"The advantages are at least twofold. The market, itself is less vulnerable to competition, and the prices of the products involved are less vulnerable to attrition. Further, in some cases at least, it gives us an opportunity to take greater advantage of our know-how and the developments of our research."

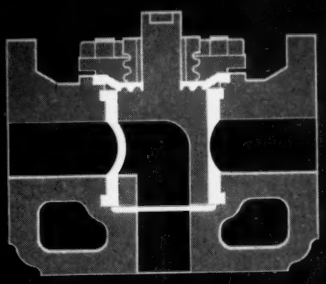
Further evidence of the same trend: Atlantic Refining Co. has just acquired majority interest in J. P. Frank Chemical and Plastic Corp., Brooklyn, N. Y. It thus acquires facilities for producing PVC, copolymer resins, films and sheeting; polyethylene film; plasticizers and stabilizers.

Desalinization Pilot Plant Shows Freezing Process

A pilot plant for converting sea water into fresh water is now being operated by Rocketdyne, a division of North American Aviation, Inc. Located near Oxnard, Calif., the plant is to demonstrate conversion efficiencies after performance characteristics of its new equipment have been checked out.

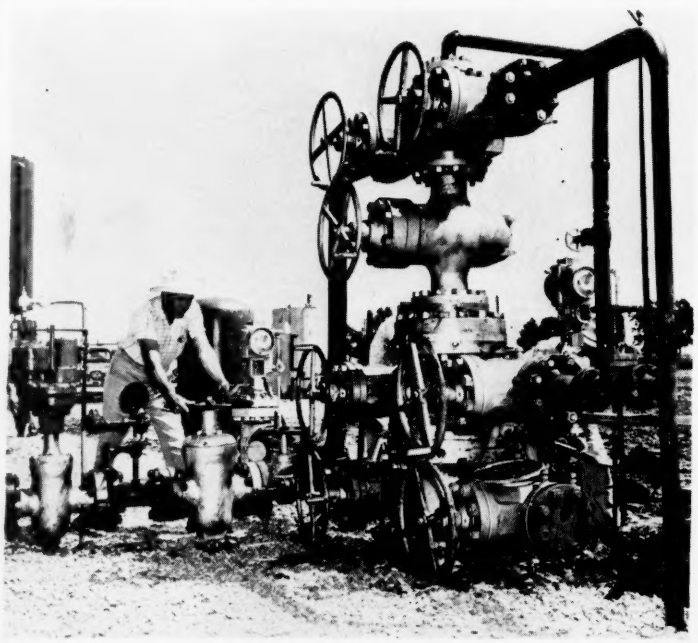
In the process, incoming sea water is cooled, then frozen to form crystals of fresh water. The crystals are then separated from the brine surrounding them, washed and melted to obtain the water. Conventional heat exchangers were not used in designing the principal sections of the freezing cycle.

symbol of modern valve design — One example: Tufline's 3-way non-lubricated valve [right]....incorporating special tempered pure Teflon™ sleeve, tapered plug and sculptured interior body bore... provides both bubble-tight sealing and ease of operation. Unusual bottom-entry design gives wrench-indicated, maximum smooth flow between ports. Available ¼" through 12", 150# and 300# class. For corrosives, light gases to heavy slurries, high vacuum to rated pressures. Choice of metals and actuation. Write Continental Manufacturing Co., 230 Park Ave., NY 17, NY



TUFLiNE valves

Cave gets first whiff of ethylene—3,600 ft. down



Opening this valve sent the first flow of gaseous ethylene whooshing into Humble Oil & Refining Co.'s 425,000-bbl. storage cavern, 3,600 ft. beneath Mont Belvieu, Tex. Humble created the salt-dome cave to stockpile petrochemical ethylene produced at its Baytown refinery, 11 miles to the southwest.

Processes

Chlorination of propylene to obtain high yields of allyl chloride is accomplished by use of a novel cyclone fan reactor, reports the June issue of *Chemicky Prumysl*, a Czech chemical journal. Starting with a propylene:chlorine molar ratio of 2-3, yield ratios around 5 (allyl chloride:unreacted propylene) were obtained. The Czech researchers believe yields could be further increased by enlarging the gas-phase cyclone reactor, thus increasing the Reynolds number in the reaction chamber.

Thin films can be applied to plastics or glass via a new process developed by Halex, Inc., El Segundo, Calif. The high-vacuum technique can deposit thin coatings of metals such as platinum, tantalum and columbium, as well as the more usual low-melting substances. Process can lay down coatings that are abrasion- and corrosion-resistant, and that possess controlled light-transmission and electrical-conduction properties.

Dry-ink printing process, using an electrostatic principle, is said by developer Stanford Research Institute to print high-quality images on virtually all surfaces. Method uses a 200-mesh stainless steel screen charged to about 1,500 v. A stencil is placed between the screen and the material to be printed; behind the printing surface is a plate of opposite polarity from the screen.

A powdered resin pigment is continually brushed onto the screen; resin is then attracted through the stencil to the surface to be imprinted. Application of heat permanently fixes the powder image to the surface. Among possible applications are printing of glass containers, decoration of hard-to-print plastics, and imprinting on delicate materials that cannot withstand pressure.

Ethylbenzene dehydrogenation catalysts of the zinc oxide type are given longer service life by adding oxides of aluminum, magnesium or calcium, or potassium sulfate and chromate, report researchers at the Synthetics Institute of Gottwaldow, Czechoslovakia. The additives are believed to increase catalyst life by stabilizing its activity.

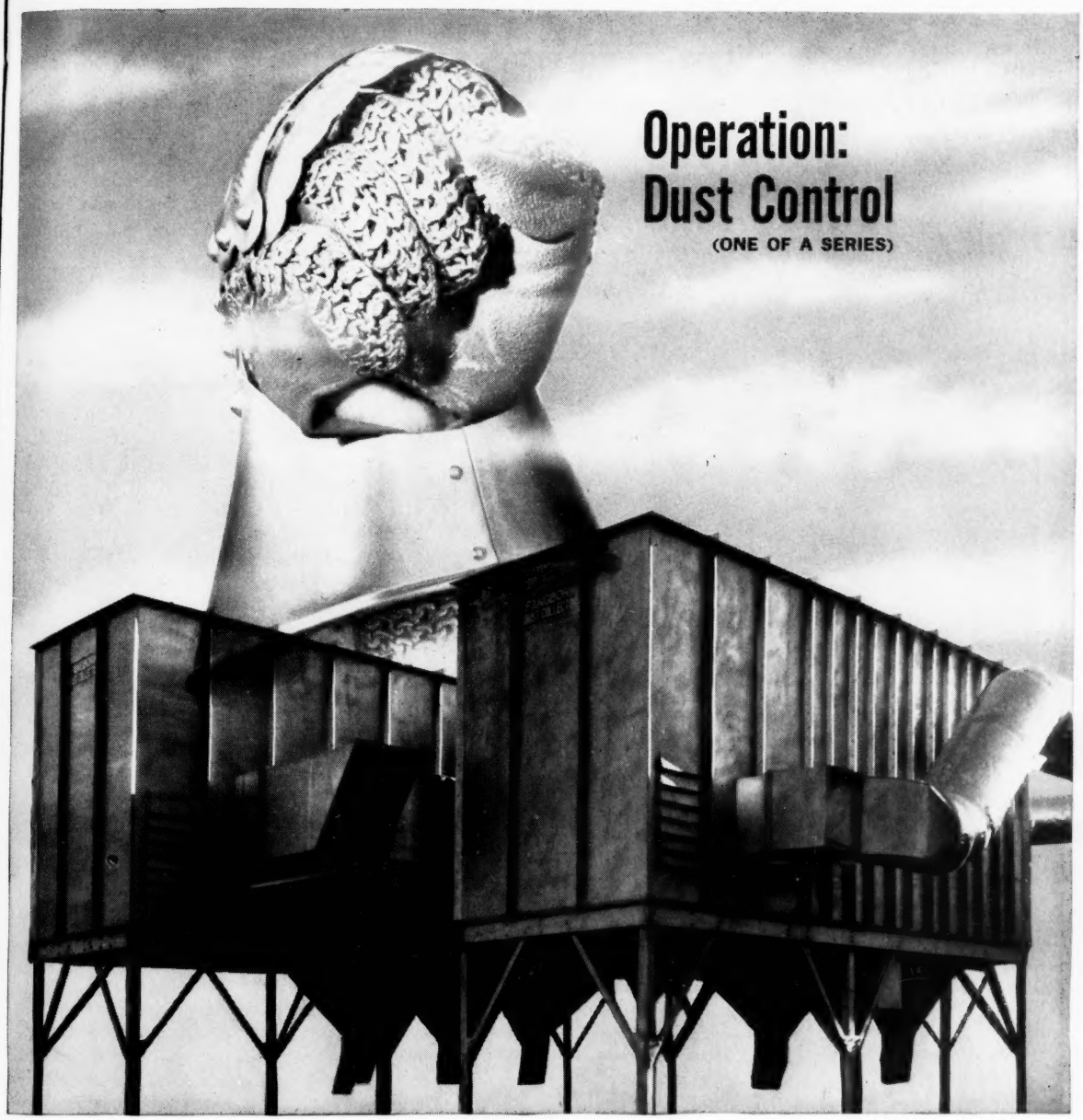
Plants

Cities Service Co. plans a 50-million-lb./yr. naphthalene plant at its East Chicago, Ind., refinery. Scheduled for completion in mid-1962, unit will convert middle distillate feedstocks into high-purity naphthalene. Bulk of the output, says the firm laconically, "is expected to be contracted for by a large chemical manufacturer."

Monsanto Chemical Co. will construct a 200-ton/day ammonia plant near Muscatine, Iowa, on Mississippi River frontage adjacent to the firm's 15,000-ton anhydrous ammonia terminal now abuilding. Due on stream in the fall of 1962, production unit will be Monsanto's third. Unlike the historic Luling, La., ammonia unit, this one will not be computer-run.

American Potash & Chemical Corp. has awarded a contract to C. F. Braun & Co. for the engineering design of its titanium dioxide plant near Mojave, Calif. First announcement of the unit came last January (*Chem. Eng.*, Jan. 23, p. 170), at which time a 25,000-ton/yr. capacity figure was projected for the $15-million facility, then slated for startup in the second half of 1962. Laporte

Turn to p. 230 for more CPI News Briefs



PROTECTOR OF YOUR PROFITS!

Dust is a destroyer. It corrodes. It abrades. It ups down-time. That's why you need protection from this menace. Pangborn Dust Control Equipment provides you with this protection.

Eliminating costly dust damage is just one of the many money-saving functions of Pangborn Dust Control Equipment. It also improves plant housekeeping. It protects men as well as equipment. It salvages usable dust. And it can improve your relations with your community.

Pangborn has the right dust collector to fit every requirement. Cloth Bag, Tube, Screen, Self-Cleaning and Unit Type Dry Collectors, also Wet Collectors in all sizes. For more facts, write:

Pangborn Corporation, 2600 Pangborn Blvd., Hagerstown, Md.; Pangborn Canada,Ltd., 47 Shaft Rd., Toronto (Rexdale), Canada —Manufacturers of Dust Control, Blast Cleaning, Vibratory Finishing Equipment; Rotoblast® Steel Shot and Grit℠.

Pangborn
OF HAGERSTOWN

New fabric doesn't melt, but it sublimes at 6,600 F.

Consisting virtually of pure carbon, this satin-like fabric, called Hitco-C, is comparable to graphite in its ablation properties, but has a lower thermal conductivity. As reinforcement in a molding compound for rocket engine parts that are subjected to the high temperature and speed of exhaust gases, Hitco-C can substitute for refractory metals or graphite throat inserts.

Whether in cloth or fiber form, this light material (specific gravity of 1.35) will team up with phenolics and other high-temperature resins in rocket nose cones, blast tubes and exit cones. It is compatible with most organic resins and with all reinforced plastic fabrication techniques such as high-pressure molding and tape winding. Other applications are in insulation, gasketing and packing, dry nonlubricated bearings, and filters for corrosive liquids and vapors.—**H. I. Thompson Fiber Glass Co., Los Angeles.** **110A**

Epoxy adhesive

Compound has very high resistance to heat distortion.

Unfilled except for thixotropic agents, a new, two-component epoxy adhesive both mixes and spreads readily, yet it adheres up to a 10-mil-thick film without sagging when applied to vertical surfaces.

Known as Sonite EA-40, this amber jellylike material hardens at room temperature, following a one-to-one mix by volume. At this mixing ratio, shear and flexural adhesion will be 2,400 psi. and 140 lb., respectively. When Sonite is mixed two parts A to one B, the shear and flexural adhesion will decrease slightly, but the heat distortion temperature will go from 163 F. to 217 F.—reported as one of the highest for epoxy cements.

The compound adheres well to metals, concrete, wood, thermosetting resins. As a bonding agent for wood, it proves far stronger than the wood itself. This does not mean it is a proper caulking compound for repairs to seams because it is not flexible enough to follow the expansion and contraction that wood undergoes when exposed to moisture.—**Smooth-On Mfg. Co., Jersey City, N.J.** **110B**

Pseudocumene

New polymethylbenzene now in commercial production.

Now produced in commercial quantities for the first time, pseudocumene (1,2,4-trimethylbenzene) can be supplied at a spot price of 11¢/lb., f.o.b., from Enjay's plant in Baytown, Tex.

A water-white liquid, this commercial grade of pseudocumene has a minimum of 98% total aromatic content and a 95% minimum purity. It has a flash point of 123 F., and boils between 335 and 340 F.

The new spot price combined with ready availability will make this compound an attractive raw material for the synthesis of trimellitic anhydride, methyl dicarboxylic acids and dimethylcarboxylic acids—all of which have potential in the surface coating field—and also for conversion to intermediate suitable for dyes, pharmaceuticals, insecticides and fungicides.

Pseudocumene is the first of several higher polymethylbenzenes to reach commercial stage. Others now in the active market development stage include mesitylene (1,3,5-trimethylbenzene), durene (1,2,4,5-tetramethylbenzene) and meta-xylene.—**Enjay Chemical Co., New York.** **110C**

Teflon

Fluorocarbon resin is now a filter material.

For the first time, Teflon is available in a felt form that will be very useful as filtration medium.

The new felts are particularly suited for applications in which

ACE

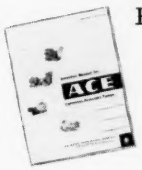
HARD RUBBER ACID PUMPS

THE PUMPS TO SEEK WHEN OTHERS LEAK...

Only a *simple* design can survive with reliability in acids, bleaches, brines and other corrosives. When Ace pumps endure for years in 12% hydrofluoric acid, switched on and off every 30 seconds, 24 hours a day, that's proof! When other Ace pumps, handling 2½ million gallons of brine, outlive 15,000 on-off cycles, that's more proof!

Working surfaces in Ace pumps are *hard rubber*... more resistant to more chemicals, stronger, tougher and more adaptable, simpler in design.

In Ace centrifugal pumps, for instance, impellers are hard rubber *molded right on the shaft.* No vulnerable threads or keys. Bladed backs of impellers keep seals clean, and the by-pass which lubricates the packing is integral with the stuffing box. Rubber-covered shaft with ring seal, or Hastelloy with conventional packing.



Here are brief details of four Ace best sellers. What you'd really like to see is the *price . . . considerably less* than most alloy metal pumps.

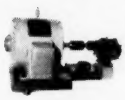
Write today. Ask for Pump Manual CE-55.

CHEMICAL EQUIPMENT DEPARTMENT

American Hard Rubber Company

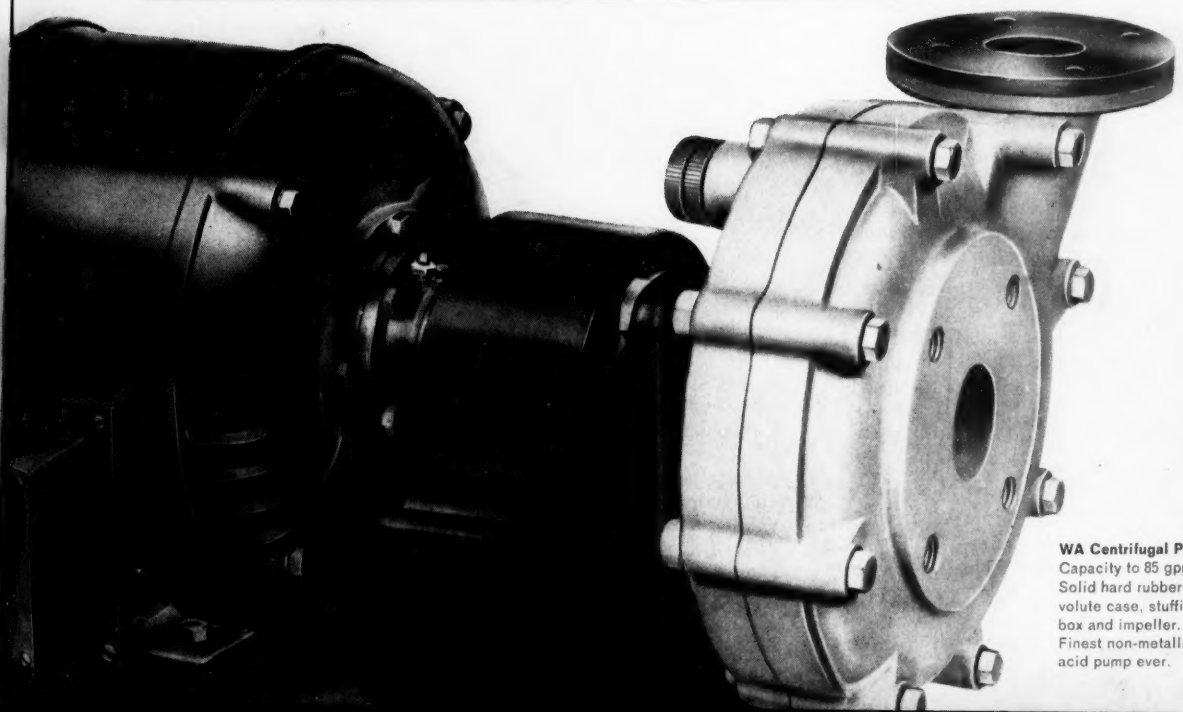
ACE ROAD, BUTLER, NEW JERSEY • Tel.: TE 8-1000

WE Centrifugal Pump: Capacity 350 gpm. Cast iron casing lined with hard rubber. Tough, hard rubber impeller.



Ace Rotary Gear Pump: Low-cost 11 gpm. acid transfer pump. Wear-resistant hard rubber gears and casing. Kel-F bearings.

Ace Jabsco Neoprene Impeller Pump: Handles amazing volume. 15 gpm. at 22 ft. head to 5 gpm. at 72 ft. Hard rubber casing, neoprene impeller. Self priming.



WA Centrifugal Pump: Capacity to 85 gpm. Solid hard rubber volute case, stuffing box and impeller. Finest non-metallic acid pump ever.

extreme conditions would damage other filtration materials. They are not attacked by acids, alkalis or solvents, and have exceptional resistance to temperatures ranging from −100 to 400 F.—sometimes, are useful up to 600 F. Efficiency of filtration is reported to be very high because the felts can remove fine particles both at high flow rates and at low pressure drops.

According to the manufacturer, this filtering medium has an unusual hydrophobic quality that permits separation of water from many organic liquids. Like most Teflon products, the felts also have a low friction coefficient and can be used in contact with moving parts.—**American Felt Co., Glenville, Conn.** **110D**

Polyepoxides

New resins have up to 5.5 oxirane groups, will esterify quickly.

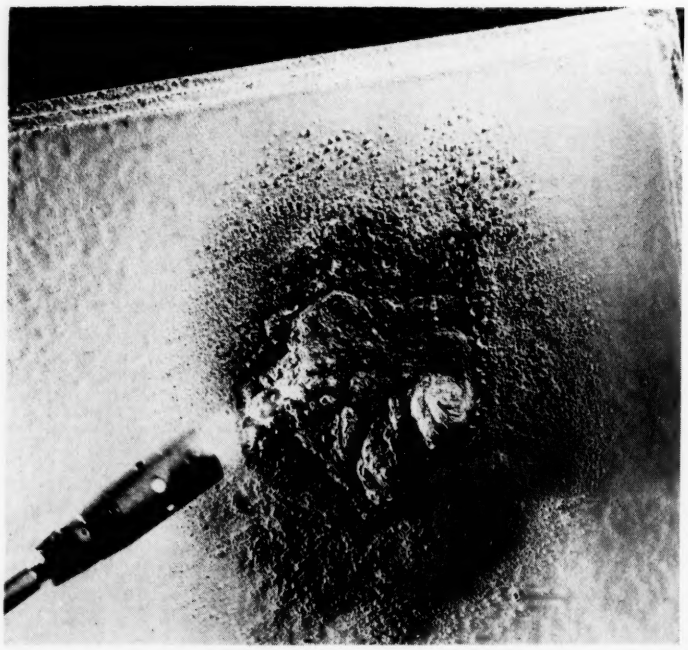
A new series of polyepoxide resins, designated KER Resins, is now in commercial production. Unlike the conventional diepoxies derived from bisphenol-A, the new resins come from the reaction of an *o*-cresol-formaldehyde novolak with epichlorohydrin.

Because of their molecular structure that permits a high degree of crosslinking, these polyepoxides improve the thermal properties and solvent resistance of cured products. A major use will be in esterification with fatty acids, to make corrosion-resistant coatings. And the several epoxy groups present in the molecule will give formulators a greater opportunity for modifying resin properties.

Esterification reactions can take place without a catalyst and at a temperature of 180 C., which is considerably below the 260 C. required for esterification of conventional diepoxides. Also, the reaction will proceed much faster.

KER resins are produced at Koppers' plant in Wyandotte, Mich., and are priced at 73¢/lb. f.o.b. — **Koppers Co., Inc., Pittsburgh.** **112A**

Halting the fire before it starts



Here is the latest intumescent coating to enter the market since early this summer (Chem. Eng., *June 26, p. 78). When exposed to a flame, the paint begins to swell and bubble, insulating the combustible substrate and preventing it from catching fire. The blistered coating can be readily scraped off and repainted.*

Called Resyn 1066, this product consists of undisclosed divalent and trivalent salts in a polyvinyl acetate emulsion of 65-75% solid content. Applied with brush, roller or spray, a 7-mil-thick coating will provide fire protection and withstand normal scrubbing.

Resyn 1066's water base permits application over damp surfaces, and dries fast enough to allow two coatings per working day. Available in several colors, it sells from 24¾ to 27¢/gal.—**National Starch and Chemical Corp., New York.** **112B**

Newsworthy Chemicals

Page number is also reader service code number

New fabric won't melt; instead, sublimes at 6,600 F.....**110A**
Epoxy adhesive resists heat distortion.....**110B**
Pseudocumene (1, 2, 4-trimethylbenzene) goes commercial.....**110C**
Teflon comes in felt form for filters.....**110D**
Polyepoxides have up to 5.5 oxirane groups, esterify fast.....**112A**
Intumescent film that foams: fires fought fast.....**112B**
Terpolymer latex of styrene, butadiene and unknown third.....**114A**
Silica foam gives continuous service at 2,000 F.....**114B**
Adipate esters make polyvinyl chloride plasticizers.....**114C**
Vanadium trichloride and tetrachloride are on the market.....**114D**
Viscosity stabilizer counteracts starch breakdown.....**114E**
Polyethylene resins are denser, stiffer.....**114F**

For more details use Reader Service Card

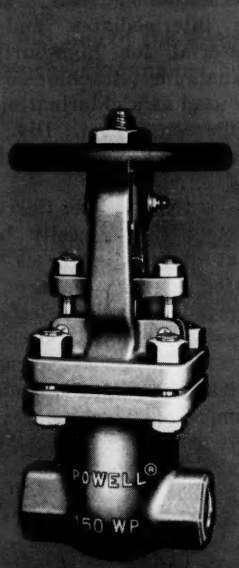
POWELL PERFORMANCE PAYS OFF

Powell valve performance really pays off for the chemical industry. Take "reliability" for instance.

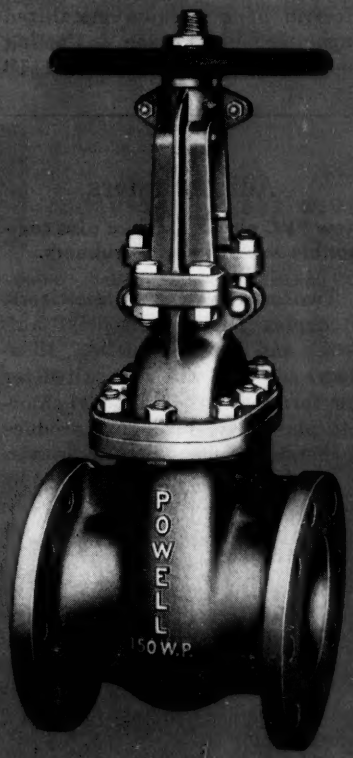
Powell reliability starts with good design features specifically tailored for chemical installations. For example, there is a deep stuffing box for an extra amount of special packing. And valve bodies are designed with full flow areas for maximum flow conditions and minimized pressure drop. Also, wedge discs are precision machined and fully guided to eliminate drag and wear of the seating surface as well as undue vibration.

You get thorough valve engineering like this—plus, industry's widest selection of valve materials, both ferrous and non-ferrous, so that Powell valves can withstand virtually any problem of corrosion, erosion, temperature or pressure. Whatever your valve requirements—look to Powell.

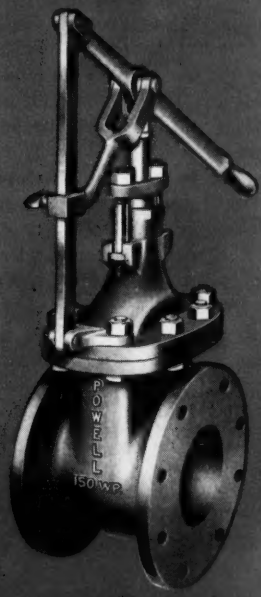
All this adds up to reliability that gives a performance pay off to you. Get the full story from your nearby Powell Valve distributor, or write The Wm. Powell Company, Cincinnati 22, Ohio.



150-pound Stainless Steel Gate Valve. Outside screw rising stem and yoke. Bolted flanged bonnet. Fully guided interchangeable solid or split wedge discs, integral seats. Screwed or flanged ends, ¼" through 2".



150-pound Stainless Steel Gate Valve. Bolted flanged bonnet. Outside screw rising stem and yoke. Accurately guided, interchangeable solid or split wedge discs. One piece yoke, 2½" through 4"; separate yoke arms, 2½" through 18".



150-pound W.P. Quick Opening Gate Valve. Bolted flanged bonnet, solid wedge, integral seats. Sliding stem can be locked in any desired position. Sizes, ¼" through 6"; with screwed ends, ¼" through 4".

Refer to our catalog in Chemical Engineering Catalog

115th year of manufacturing industrial valves for the free world

POWELL CORROSION-RESISTANT VALVES

THE WM. POWELL COMPANY CINCINNATI 22, OHIO

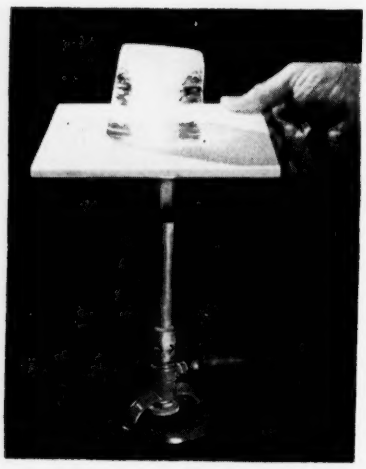
Latex

Compound increases stiffness of rubber latexes.

Described as a terpolymer of styrene, butadiene and an undisclosed third monomer, Marmix 16123 latex has the ability to modify the physical characteristics of such film-forming latexes as natural and nitrile rubber, SBR and neoprene.

At a level of 5-20 parts, Marmix increases the stiffness or modulus of both cured and uncured rubber latexes. But unlike mineral fillers, such as clay or whiting, this is accomplished with an improvement in tensile strength and without lessening the tear strength, water resistance and stability of the dried latex blend. At modifications of 15% or greater, the new latex imparts thermoplasticity to rubber compounds. This characteristic can be valuable for products that must be embossed or postformed.

Marmix is also a reinforcing agent in dipped or foamed latex goods, textile and specialty coatings, and rug backings. Price: 27½¢/lb.—**Marbon Chemical, Washington, W. Va.** 114A



Silica foam

Material is capable of continuous service at 2,000 F.

Although placed directly over a flame, this thin sheet prevents the ice cube on top from melting. Called Eccofoam SI, the new product consists of more than 95% silica and is of extremely fine-grained structure with cells smaller than 100 microns in diameter. It can be glazed to a water-impervious, hermetically sealed foam.

Rugged and easily machined, Eccofoam is very light (density 0.7 gm./cc.), can be bonded to itself and to many other materials. It has a low thermal conductivity of 1.3 Btu./hr.(sq. ft.)(F./in.) and a breaking strength of 800 psi.

Because of its properties, the new foam will be used as a radio-frequency insulator in microwave transmission lines, and as the dielectric of a vacuum metallized capacitor. — **Emerson & Cuming Inc., Canton, Mass.** 114B

Adipate esters

New PVC plasticizers are also compatible with synthetic rubbers.

Two new adipate plasticizers, Monoplex DIOA (diisooctyl adipate) and Monoplex DDA (diisodecyl adipate), are well suited for the formulation of polyvinyl chloride plastisols since they produce dispersions that are low in viscosity and hence easily handled by standard production techniques.

As a primary plasticizer for various vinyl chloride resins, diisooctyl adipate has good processing characteristics for calendering, extruding, and dispersion compounding. It is a chemically stable ester that gives compounds satisfactory stability to heat and ultraviolet light.

Soluble in common ketones and lower alcohols, diisooctyl adipate builds up the low-temperature properties in such products as garden hose, table cloths, rainwear.

It is compatible with polystyrene, polypropylene, polyvinyl butyral, polyvinyl acetate, cellulosic esters and various synthetic rubbers.

Similar to the octyl adipate in the ability to improve calendering and extrusion, diisodecyl adipate has lower volatility and improved resistance to extraction by aqueous media.—**Rohm & Haas Co., Philadelphia.** 114C

Briefs

Vanadium trichloride and tetrachloride are now produced in pilot-plant quantities. The trichloride is available as a free-flowing, deep purple crystalline powder of 98% purity. The tetrachloride is a dark, red-brown liquid of 95% purity. Suggested uses include stereospecific polymerization catalysts, organometallic intermediates, and starting material for high-purity metal. Vanadium tetrachloride can also be used as a chlorinating agent.—**Anderson Chem. Div., Stauffer Chemical Co., New York.** 114D

Viscosity stabilizer Corragel counteracts the viscosity breakdown that starch undergoes when exposed to the action of shearing forces. Corragel is described as a crystalline inorganic material (activated by thermal treatment to thicken or gel when under shear), compatible with all starch adhesive systems. It is reported to add body, making a tighter bond.—**Minerals & Chemicals Philipp Corp., Menlo Park, N.J.** 114E

Polyethylene resins Hi-fax 2000, 2100 and 2200 have been prepared with new Ziegler catalyst recipes that make possible higher densities (0.962) and higher stiffness than for similar products. In film and paper-coating applications, they bring maximum rigidity and flexural stiffness. In injection molding, the resins are said to open up a whole new field for polyethylene molded objects, which are adequately stiff in thin sections without becoming brittle or subject to flex-cracking.—**Hercules Powder Co., Wilmington, Del.** 114F

For more information about any item in this department, circle its code number on the Reader Service Postcard (Page 269).

Houdry blueprint for dehydrogenation utilizes Mutual Chromium Chemicals

Houdry Process Corporation, Philadelphia, Pa., uses Mutual® Chromium Chemicals as basic ingredients in their chrome-alumina catalysts. They have found that Mutual quality meets their stringent specifications. This consistent purity is important to catalytic life and performance in the unique one-step dehydrogenation process developed and licensed by Houdry for producing butadiene from normal butane.

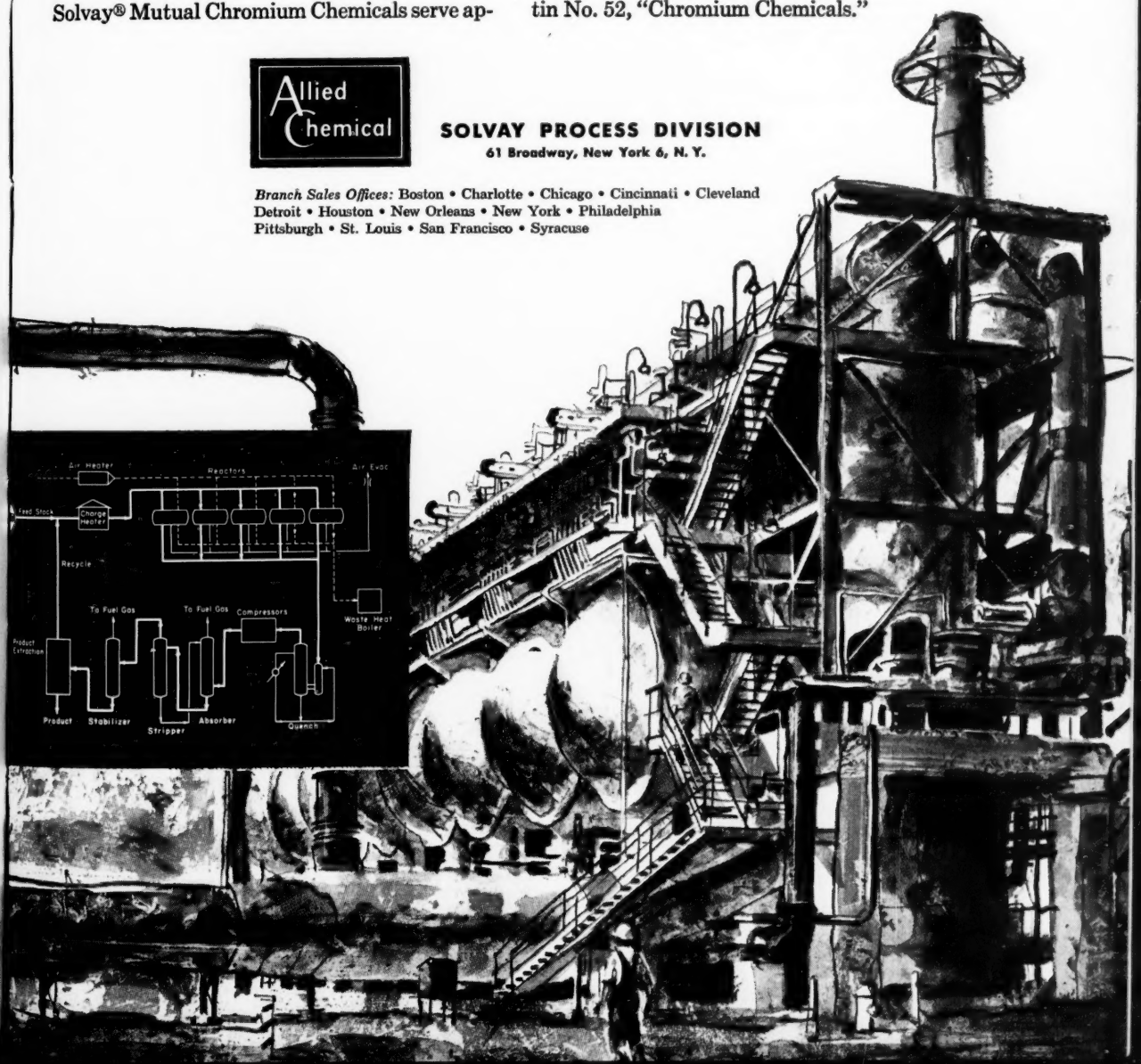
This is just one of the many ways versatile Solvay® Mutual Chromium Chemicals serve applications ranging from metal treatment to fireworks. To fill your needs for any of the Mutual Chromium Chemicals, look to Solvay. With over 100 years' experience in their development and production, Solvay is the world's largest chromium chemical producer.

For a full description of the Mutual line of chromium chemicals, uses, properties, and comprehensive technical data . . . write for your free copy of Solvay's new 80-page Technical Bulletin No. 52, "Chromium Chemicals."

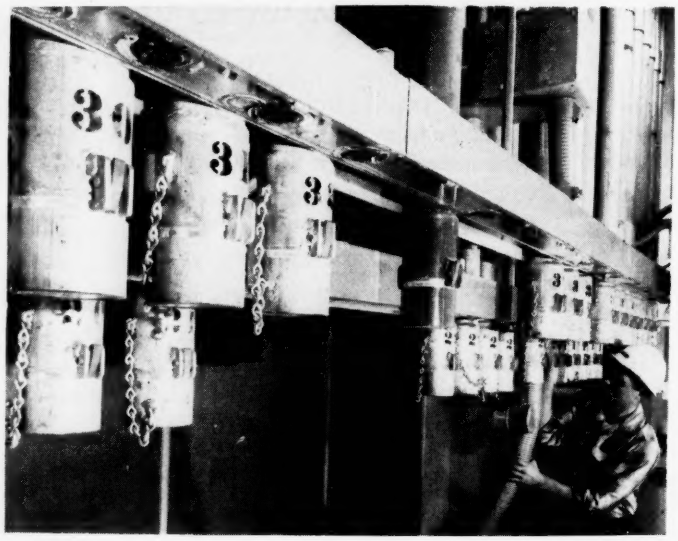
Allied Chemical

SOLVAY PROCESS DIVISION
61 Broadway, New York 6, N. Y.

Branch Sales Offices: Boston • Charlotte • Chicago • Cincinnati • Cleveland
Detroit • Houston • New Orleans • New York • Philadelphia
Pittsburgh • St. Louis • San Francisco • Syracuse



Switching station simplifies solids storage



The operator is not checking the pipes of a giant organ, but hooking up a flexible hose to direct the flow of polyethylene resin into one of a battery of storage bins at Dow Chemical Co.'s Dobeckmun Div., Fresno, Calif. The pneumatic conveying system can unload the pellets from incoming railroad hopper cars or reclaim polyethylene from storage. The extremely flexible system not only has reduced handling costs and decreased spillage, but has reduced dust in the plant and all but eliminated the possibility of material contamination from handling.—**Dracco Div., Fuller Co., Cleveland.** **116A**

Portable oxygen analyzer

Trace quantities are detected in a variety of common gases.

A portable oxygen analyzer with three basic ranges—0-20, 0-100 and 0-1,000 ppm. by volume—can detect oxygen present in argon, nitrogen, helium, methane, ethylene, hydrogen, carbon dioxide and many other gases.

Battery operated, the unit instantaneously responds to a sudden change in oxygen concentration in the sampled gas. Oxygen is reduced in an electrolytic cell, with the electrolysis current calibrated to oxygen content.

Accuracy is said to be 5% of the indicated oxygen content or 0.1 ppm., whichever is higher. The 30-lb. unit has terminals available for adding a recorder if a permanent record is needed. Sample pressure must be regulated between 15 and 30 psi.; a brass regulator is provided, although a stainless steel one can be supplied. The rest of the unit is stainless steel. —**Lockwood & McLorie, Inc., Horsham, Pa.** **116B**

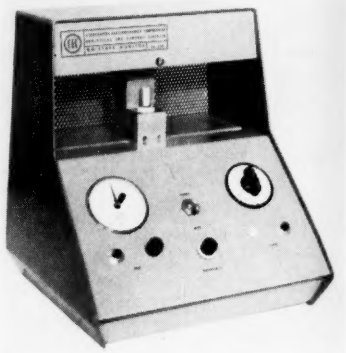
Process monitor

Up to 10 points are checked to find deviation from set point

From 1 to 10 process points generating d.c. milliv. outputs can be monitored by this instrument and checked against a pre-established set point. High or low deviation will cause the device to give a visual indication of the trouble and shut down the process.

Each point is scanned in sequence in from 1 to 10 sec., depending on individual requirements. Manipulation of the set-point dial will indicate the exact condition of any point if the magnitude of its deviation is desired.

The instrument is continuously standardized by a constant-voltage power supply. Calibration accuracy is 0.25% of full-scale span. —**Thermo Electric Co., Inc., Saddle Brook, N. J.** **116C**



Monoxide analyzer

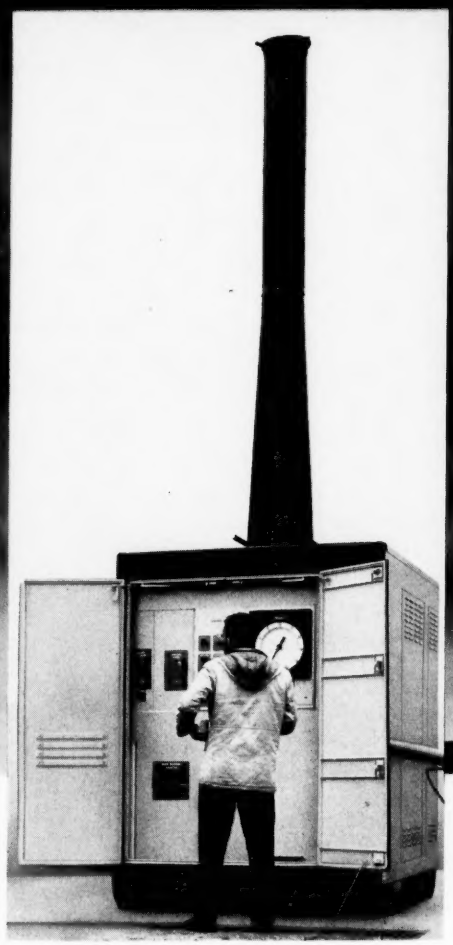
Determine carbon monoxide concentration continuously.

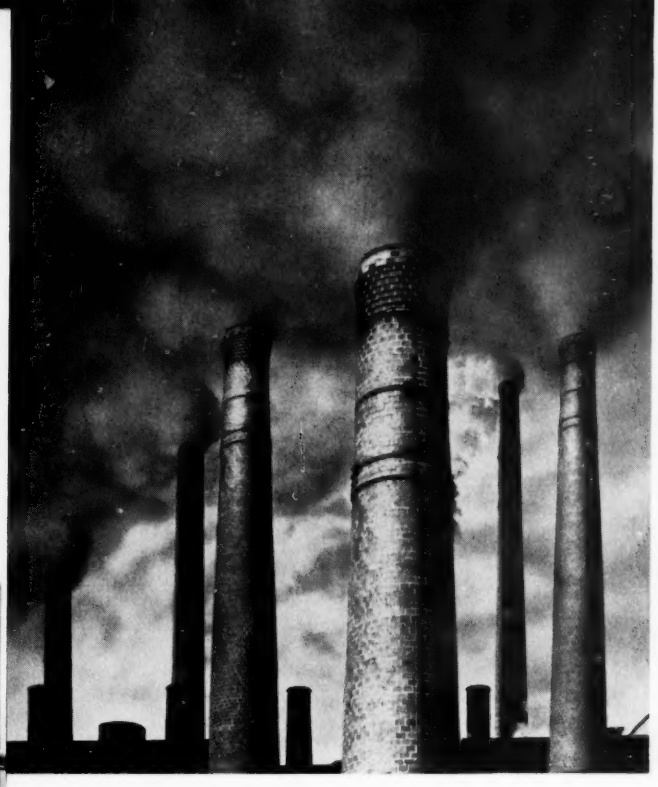
As a continuous analyzer, this unit can report carbon monoxide content of gases used in heat-treating operations, monitor CO in air-pollution studies, and check on leakage in chemical plants. For intermittent service, it measures the production of CO from chemical reactions, and determines the CO content of gas mixtures within closed tanks.

In operation, the difference in infrared radiation between a sample tube and a reference tube that are placed between a filament and an infrared detector is measured and compared. The difference is displayed on a scale reading directly in percent CO.

The unit is available with an

Stop the toxics with a Pyron System!





DIRECT ATMOSPHERIC DISCHARGE
THERMAL DECOMPOSITION
COMPLETE OPERATIONAL SAFETY

Regardless of where your plant is located – even in a populated area – you can now process your toxic wastes and discharge the detoxified gases directly to atmosphere. Avien's Pyron System will thermally decompose more than 40 dangerous vapors and liquids common to industrial processing. There is no further need for scrubbing operations with the resultant disposal problem.

Originally designed by Avien for Titan II missile application, the Pyron System is capable of processing various liquid and vapor compounds in the carbon-hydrogen-oxygen-nitrogen class. Hydrocarbon fuels, such as propane, are utilized as the primary heat source, and all system components are commercially available items. The decomposition process is achieved by pyrolysis, combustion, or a combination of both. Pyron units are available with automatic or manual control features.

Laboratory model also available

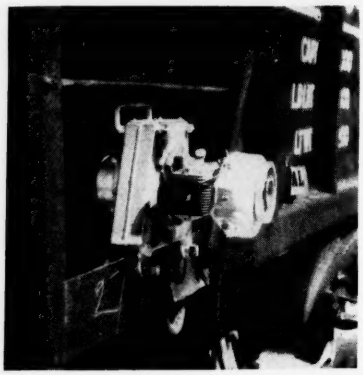
Pyron units are designed for your special application. Your requirements determine overall size and capacity of the unit, giving you a tailored compactness never before available. The Pyron unit is a safe, economical means for disposing of toxic wastes.

Write today for free brochure describing applications, operation, design and costs, Avien, Inc., 125 Gazza Blvd., Farmingdale, Long Island, N.Y.

Avien, INC. *58-15 Northern Boulevard, Woodside, New York*

integral sampling pump, flowmeter and pressure regulator. It can be used for sampling from compressed gas lines or from the open air. A jack is provided for connection to a standard strip-chart recorder for continuous permanent records.

Standard range is 0-0.5% and 0.03-0.25%. — **Gelman Instrument Co., Chelsea, Mich.** 116D



Hopper car vibrator

Portable gasoline-operated unit clamps on, empties car quickly.

Hard-to-remove solids yield to this vibrator that develops sufficient force to unload an entire car from one location without manual assistance. Producing an unbalanced force of 6,600 lbs., the 77-lb. unit clamps to any rigid angle.

Because it requires no external power source, the gasoline-driven device is suitable for unloading cars at remote sites. One man can perform all unloading operations without getting into or under the car.—**Martin Engineering Co., Neponset, Ill.** 118A

Plastic pipe

Designed for corrosive applications at severe conditions.

High pressures and temperatures are successfully combated by a new plastic pipe whose joint strength is greater than that of the pipe itself. Internal liner, cocured with a reinforced core, is offered in different materials for petroleum or chemical service.

The core is made of filament-wound glass fibers bonded with butadiene-styrene resin. Cover and liner of the pipe for petroleum service are made of a blend of nitrile rubber and PVC, making pipe wrap or painting unnecessary for outdoor or underground applications.

Present product has a maximum operating pressure of 500 psi. at 80 F.; pipe for 1,500-psi. working pressure will be available in the near future. Maximum operating temperature is 250 F.

Pipe is now available in 20-ft. lengths, 2-in. diameter. By the middle of next year, 3- and 4-in. sizes will be in production.—**Spiral-Glas Pipe Co., Old Bridge, N. J.** 118B

Metering pump

Precalibrated knob sets liquid flow with accuracy of ±2% of range.

This metering pump that delivers minute quantities of a variety of liquids is suitable for application in pilot-plant operations, organic synthesis research, reaction-rate and drug infusion studies.

Repeatability is better than ±0.5% of rated capacity, and accuracy is ±2% of full range. Flow rate is set with a precalibrated knob that reads to thousandths of milliliters per minute.

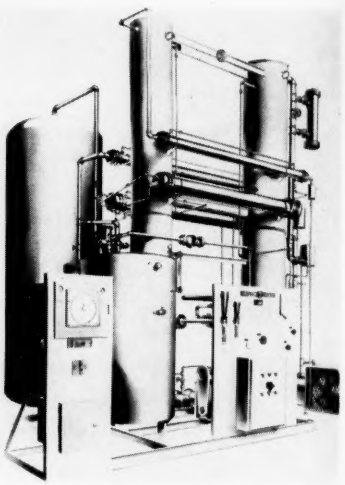
Internals are made of highly inert materials to permit handling of most corrosive fluids. Sterilization is possible. Mechanically actuated valves develop leak-free performance without high back-pressures. Models have capacities of 0-2, 0-5, 0-10 or 0-20 milliliters/min. — **Beckman Scientific and Process Instruments Div., Fullerton, Calif.** 118C

Gas analyzer

Unit is designed to measure gas components in hot atmospheres.

A new analyzer provides direct-trend recording of up to eight components in gas mixtures present in furnace atmospheres. Operating on the principle of gas chromatography, the unit gives quantitative analysis for hydrogen, oxygen, nitrogen, carbon monoxide, carbon dioxide, methane and water vapor.

Turning out an analysis every five minutes, the instrument is automatically standardized for each cycle. Built for application in industrial plants, it contains no delicate optics or glassware.—**Research and Control Instruments, Inc., Woburn, Mass.** 118D

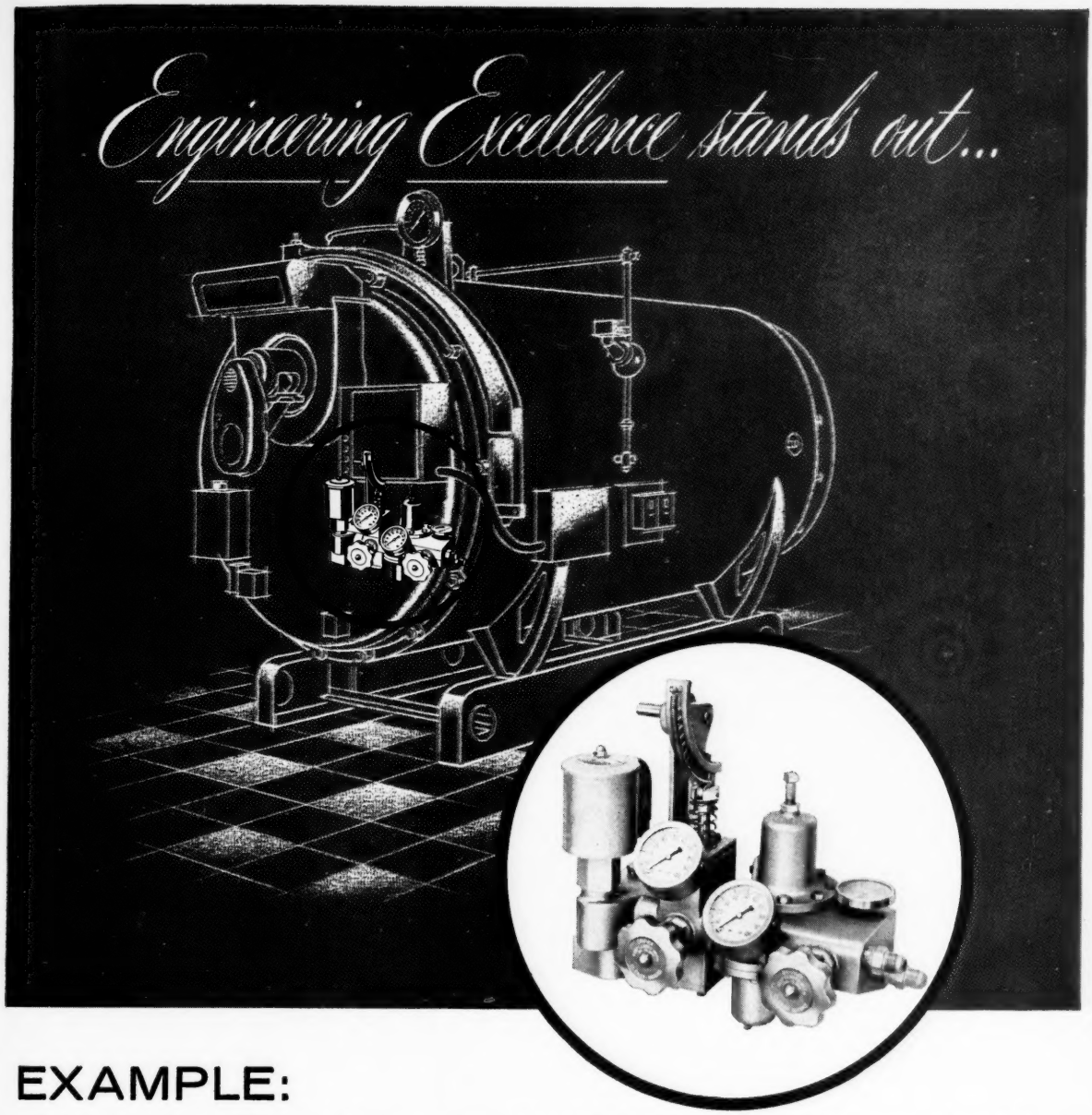


Nitrogen generator

Device provides pure product for purging, blanketing, packaging.

Nitrogen gas can be produced when and where it is needed with a packaged generator that gives

Engineering Excellence stands out...



EXAMPLE:
Cleaver-Brooks exclusive *fuel oil controller*

The Cleaver-Brooks fuel oil controller is unique in the industry. It combines in one steel casting all the piping, gauges, regulators, and valves needed in the integral fuel oil control system. Leakage is virtually eliminated because this single assembly eliminates as many as 40 fittings and pipe elbows. There's a clean, uncluttered, efficient look to the head of every Cleaver-Brooks boiler.

Look to Cleaver-Brooks for many examples of engineering excellence in action. The single tip burner nozzle, so easy to remove and clean . . . the rotary air damper that gives precise control of air . . . the air nozzle purge . . . all are found exclusively on Cleaver-Brooks boilers, all contribute to greater efficiency in the burning of fuel. Good reasons why you should *insist* on Cleaver-Brooks.

Your Cleaver-Brooks agent has years of experience in boiler application. Contact him for more information on the features that exemplify the engineering excellence of Cleaver-Brooks.

Write for free booklet, "How to Select a Boiler."

Cleaver Brooks®

ORIGINATOR AND LARGEST PRODUCER
OF PACKAGED BOILERS
Dept. L, 345 E. Keefe Ave., Milwaukee 12, Wis.

PERFORMANCE PROVES THE ENGINEERING EXCELLENCE OF CLEAVER-BROOKS BOILERS

a product essentially free of all impurities except oxygen, which is limited to 90 ppm. or less. The gas is delivered at 135 psi., for blanketing chemical and metallurgical processes, pressurizing shipping containers, and purging process lines or vessels.

In operation, a sulfur-free hydrocarbon fuel gas is burned with air over a catalyst. The products are further oxidized to remove traces of carbon monoxide and hydrogen. A chemical absorbent removes most of the carbon dioxide, then a molecular-sieve regenerative dryer removes essentially all water vapor and residual carbon dioxide.

An oxygen analyzer continuously analyzes and controls the product gas. — **General Electric Co., Schenectady, N. Y. 118E**

Moisture analyzer

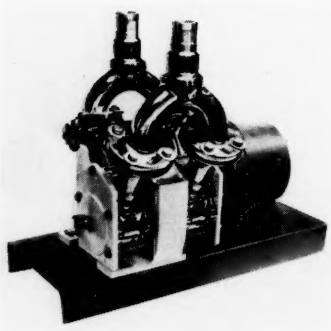
Device uses an electrolytic cell to measure moisture in solid samples.

With an accuracy claimed to be better than 2%, a new moisture analyzer that is specific to water can turn out an analysis in about ten minutes.

In operation, a weighed sample is placed in a small oven, where water is driven off by heating. Water vapor is picked up by a carrier gas and transferred to the sensing element.

Mass flow rate of the entrained water, represented linearly by an electrolytic cell current, is integrated by an electromechanical motor that provides a direct readout in micrograms of water. The instrument is accurate to ±5 micrograms, down to 10 micrograms. Range is 0.1 microgram to 1.0 milligram per complete cycle of the integrator. — **Consolidated Electrodynamics Corp., Pasadena, Calif. 120A**

For more information about any item in this department, circle its code number on the Reader Service Postcard (Page 269).

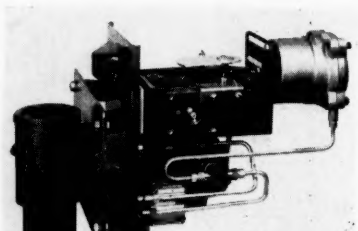


Sealless Pump

Self-priming duplex, with 40-gpm. capacity, handles viscous fluids.

Good for sanitary or other noncontaminating service, this sealless pump has no rotating parts in contact with the fluid. Capacity has been increased from a maximum of 20 gpm., in a former single-stage design, to 40 gpm.

Pumping is accomplished by a rotor on an eccentric that turns inside a replaceable flexible liner. A progressive squeegee action is created on fluid trapped between the liner and the stainless steel body block. Self-priming, the pump operates wet or dry and can handle slurries or viscous materials—**Vanton Pump & Equipment Corp., Hillside, N. J. 120B**



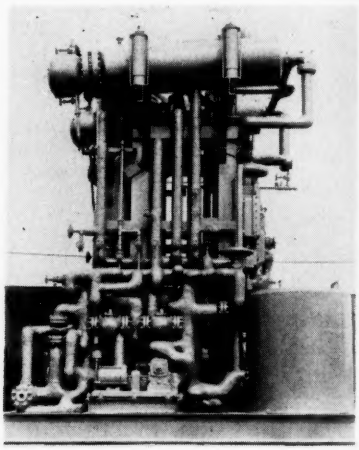
Ratio computer

Unit provides direct measurement of flow ratios; monitors rates.

Flow ratios are measured directly by a new pneumatic computer that replaces a conventional ratio device and two square-root-extracting devices in pneumatic control systems. Available in ratings of 3 to 5 psi., the device can be applied to new or existing systems.

As an added feature, it will sound an alarm or limit the flow of one liquid when ratios exceed a critical point. Output can be recorded for historical purposes or for reference in developing related liquid ratios for other processes.

The unit's output can also be used as a measured variable input to a controller. The set point, or controlled-flow ratio, may be adjusted from: a manual control station, measurement of the total flow, or an analysis of the characteristics of the final stream. Accuracy is 1%.—**Republic Flow Meters Co., subsidiary of Rockwell Mfg. Co., Pittsburgh. 120C**

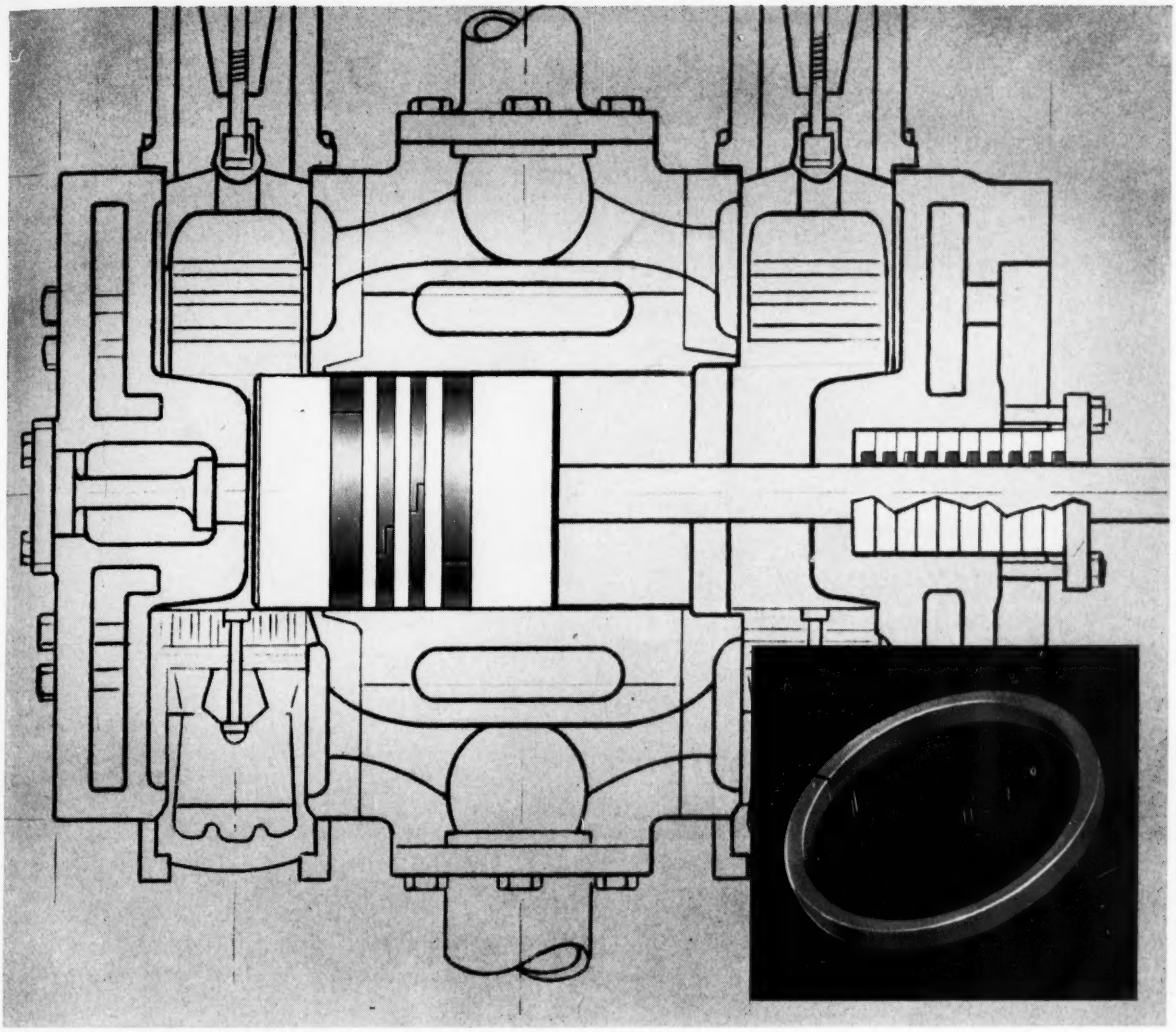


Gas Generator

Hydrogen sulfide unit yields gas from liquid sulfur and hydrogen.

For hydrogen sulfide needs that can't be met practically with cylinders, this generating plant can provide up to 5 tons/day. Based on a new process developed by the manufacturer, the plant utilizes the reaction of hydrogen with liquid sulfur at elevated temperature and pressure. Operating requirements include hydrogen, liquid sulfur, electric power, steam and cooling water. Skid-mounted, the unit is shipped partially assembled, with a minimum of work

New Equipment continues on page 248



How piston rings of TEFLON® eliminated fire hazard and saved $4,500 per year

Oil contamination in an instrument air system caused serious problems in a large manufacturing plant. Oil plugging the lines not only led to heavy maintenance costs, but also created a dangerous fire hazard. Converting the eight instrument air compressors to piston rings of TEFLON solved the problems and saved the plant money.

The greatly reduced lubrication required with rings of TEFLON (no oil at all was added to the cylinder) eliminated the oil contamination and system plugging. In addition to cutting maintenance costs substantially, the rings of TEFLON lasted longer than previously used carbon rings, saving $3,000 per year in ring cost, and virtually eliminated cylinder wear, saving another $1,500 in cylinder refinishing.

Piston rings of TEFLON are your most logical and economical choice whenever reduced lubrication would be desirable . . . whenever problems of product contamination arise . . . whenever ring brittleness causes handling, installation, or operating difficulties. If you are buying a new compressor, specify rings and packings of TEFLON TFE resin. To convert your present equipment, check with your compressor manufacturer or qualified ring supplier for engineering and design assistance. For more information write to: E. I. du Pont de Nemours & Co. (Inc.), Dept. CE-10, Room 2526, Wilmington 98, Delaware.
In Canada: Du Pont of Canada Limited, Box 660, Montreal, Quebec.

DU PONT TEFLON® FLUOROCARBON RESINS

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

TEFLON is Du Pont's registered trademark for its family of fluorocarbon resins, including TFE (tetrafluoroethylene) resins and FEP (fluorinated ethylene propylene) resins.

ASK PHILADELPHIA!

Adding or removing heat in a process mixing operation is tricky. Improper baffling in any mix may permit swirling and drastically reduce the efficiency of coil type heat transfer surfaces.

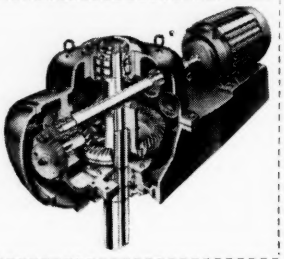
With viscous liquids, particular care is needed. Because stagnant zones must be avoided, baffling may have to be reduced or eliminated . . . and impeller size and speed must be chosen carefully to minimize swirling.

Want help with a critical process? Try Philadelphia. Philadelphia's engineering staff has dealt with hundreds of unique applications—can find new answers *fast* through skilled pilot process research.

Good General Rule: In promoting heat transfer, determine the flow pattern that will give the best transfer conditions—then get the mixer that provides it.

Best General Rule: Ask Philadelphia about mixers *and* mixing. Philadelphia Mixers do what they're sold to do. Philadelphia Mixers *mix*.

Here's the Secret of trouble-free mixing: gears precision-ground to master gear perfection. Tougher, quieter, more powerful—the best mixer drives made are made by Philadelphia.



Get Facts—and plenty of them—on mixer design, construction, and specification. Sections of *Fluid Mixing Practice* and *Process Mixing Technology* detail steps you can take to improve process efficiency. Read how to be sure of correct mixer design every time. Request 64-page Catalog A-19 on your letterhead today.

PHILADELPHIA MIXER

DIVISION OF PHILADELPHIA GEAR CORPORATION

King of Prussia (Suburban Philadelphia), Pennsylvania

AGMA MEMBER

ASK ANY ENGINEER / GEARS ARE THE HEART OF A MIXER

DAY-TO-DAY VERSATILITY . . .
LONG-RANGE FLEXIBILITY!

Improve, Expand and Diversify

YOUR FILTRATION OPERATIONS WITH A SPERRY FILTER PRESS

You buy a Sperry Filter Press for a specific application. Then you find yourself improving your product — making process changes — adding new products — saving vital production dollars and increasing income.

Sperry stimulates progress of this sort because its plate and frame construction does not limit your production capabilities. A Sperry press can be used for a multitude of applications — go from one chamber to full capacity; handle most filterable mixtures using most media, even paper alone; and easily change products as required by your production schedule.

Consider this flexibility of operation the next time you're looking for a new filter. And remember, a Sperry Filter Press still costs less to own and operate. Write today for details and a free copy of the new Sperry catalog.

D. R. SPERRY & CO.
Filtration Engineers
BATAVIA • ILLINOIS

Sales Representatives

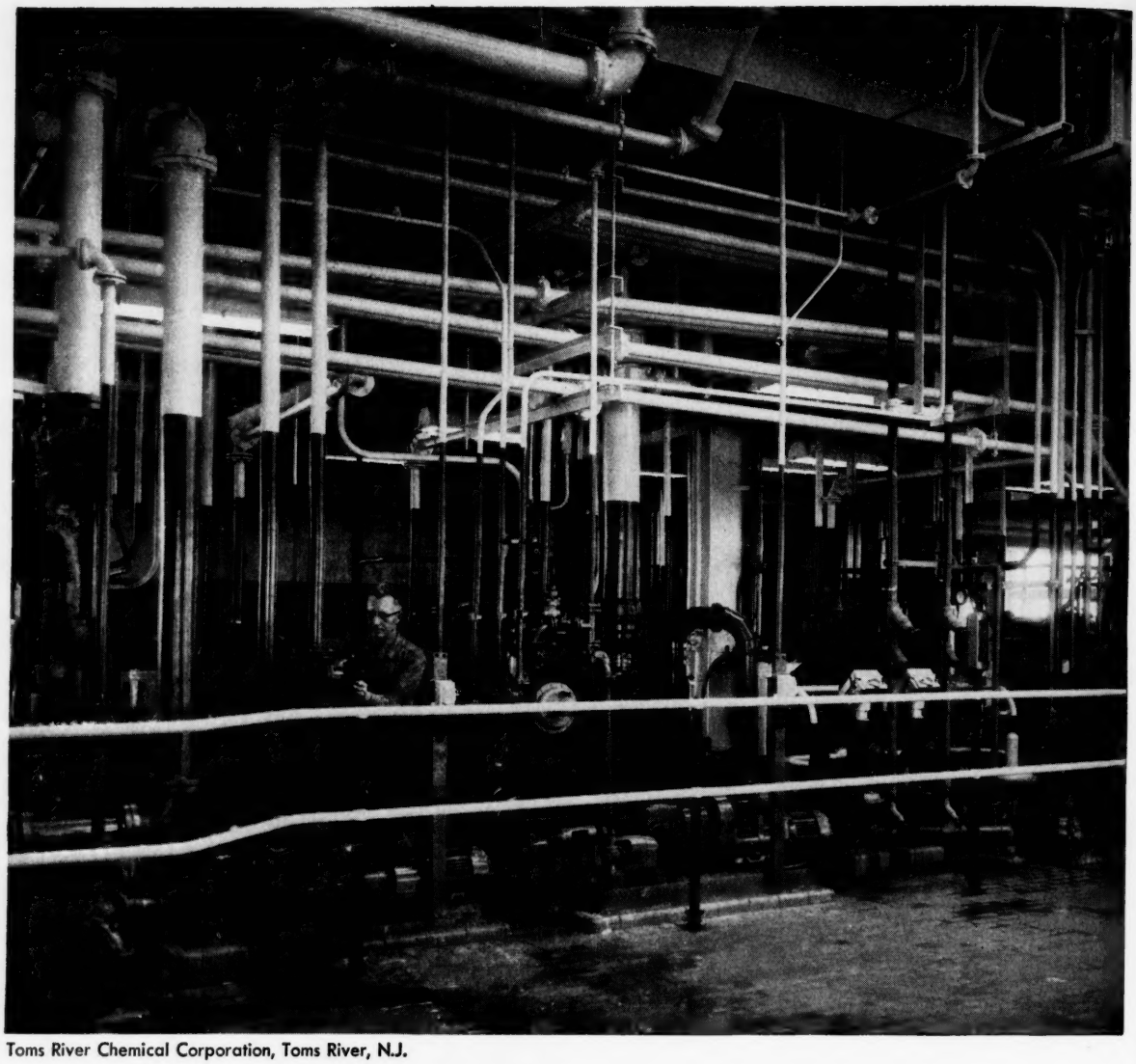
George S. Tarbox—808 Nepperhan Ave., Yonkers, N.Y.
Texas Chemical Eng. Co.—4101 San Jacinto, Houston, Texas
B. M. Pilhashy—833 Merchants Ex. Bldg., San Francisco, Cal.
Alldredge & McCabe—847 E. 17th Ave., Denver, Colorado
The Gilbert Tramer Co.—1217 Main Ave., Cleveland, Ohio
Galloway-Ratcliffe, Inc.—4056 Lindell Blvd., St. Louis 8, Mo.

D. R. SPERRY & CO.
Batavia, Illinois, Dept. CE-10

☐ Send Free Sperry Catalog
☐ Have Your Representative Contact Us

Name_____
Company_____
Address_____
City_____ State_____

CE-61-8



Toms River Chemical Corporation, Toms River, N.J.

SARAN LINED PIPE—no failure after 10 years carrying hot acid loads

Thousands of feet of pipe carry a constant flow of corrosive acids, wet chlorine, sodium hydroxide . . . at temperatures ranging as high as 185° F. . . . where downtime can't be tolerated. Here in the dyestuffs plant of Toms River Chemical Corporation, Toms River, N.J., Saran Lined Pipe delivers its reactive loads year-in, year-out, and needs no time out for repairs.

"Even after 10 years, Saran Lined Pipe needs no replacement or repair," say company officials. "The only maintenance has been cleaning and exterior painting, with occasional servicing of the saran lined valves. For our plant conditions, this is the best, most economical carrier for most of the acids and chemicals we use—HCl, H_2SO_4, SO_2, Cl_2, NaOH, and others.

"Unlike other kinds of piping, we can easily cut and assemble Saran Lined Pipe in the field. When errors in measurement occur, they cost far less to correct with Saran Lined Pipe than with other kinds."

For carrying even the most corrosive of chemicals, consider Saran Lined Pipe. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can be easily cut, modified and fitted in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 1564AK10-16.

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

HARBISON-WALKER

DURO acid-proof TILE

For the most durable chemical resistant floors

Duro tile are dense and non-absorbent throughout their entire thickness and are not dependent upon a skin glaze for resistance to penetration by corrosive liquids. The smooth, non-glassy surface of Duro is good for traction and the avoidance of slippage. Surfaces can be textured if desired.

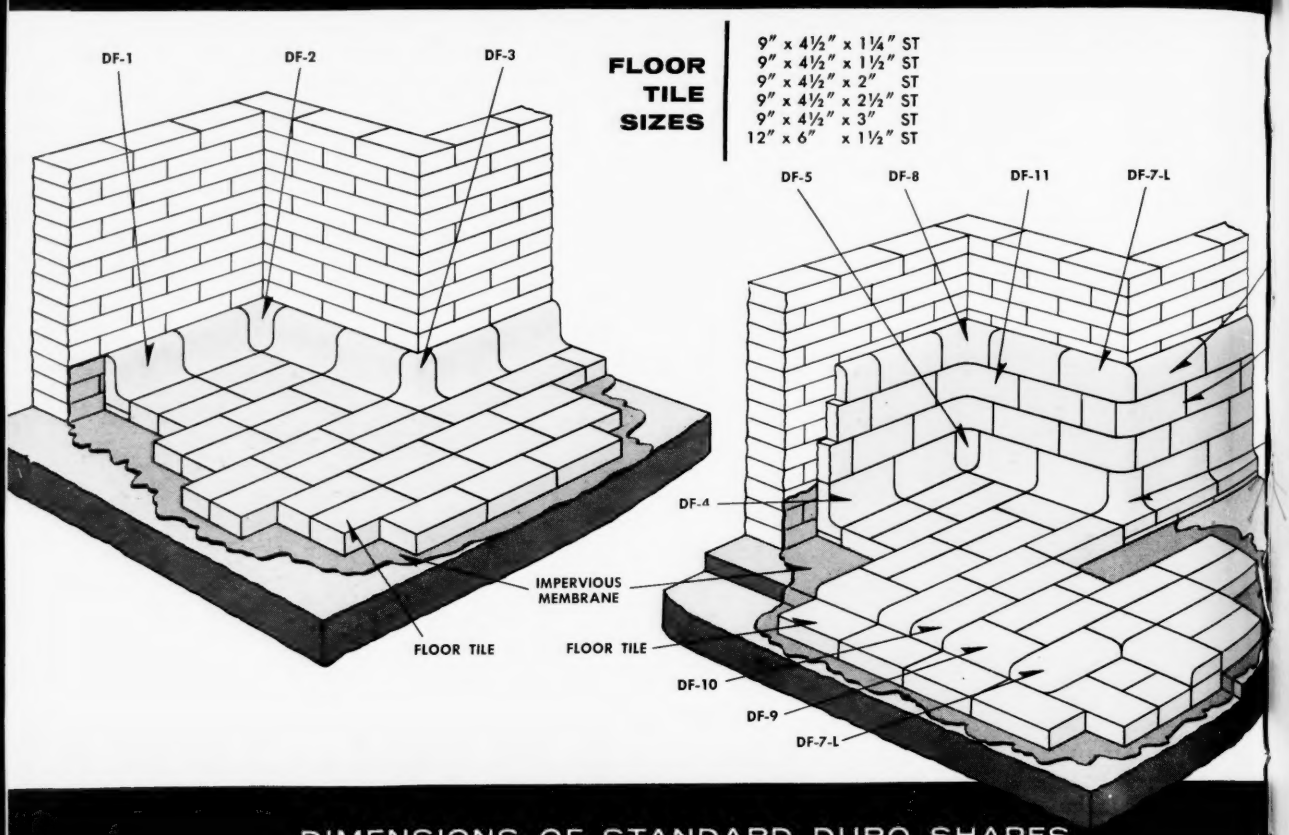
Duro is vitreous to the most desirable degree for high strength to withstand impact and abrasion and for maximum impermeability and resistance to chemical action. This combination of properties is attributable to its stabilized chemical composition of aluminum silicate which is exceedingly low in the more soluble basic fluxes, such as iron oxide and alkalies, the vacuum method of forming and the high temperature at which it is fired. Its mineral constituents are converted to the most stable forms of greatest insolubility in acids and various corrosive materials.

The light buff color of Duro, with freedom from the glare caused by glazed surfaces, contributes to the clean, sanitary appearance of the floors. The excellent workmanship of Duro tile and the variety of cove base shapes makes readily feasible a neat close fitting construction that is easy to keep clean.

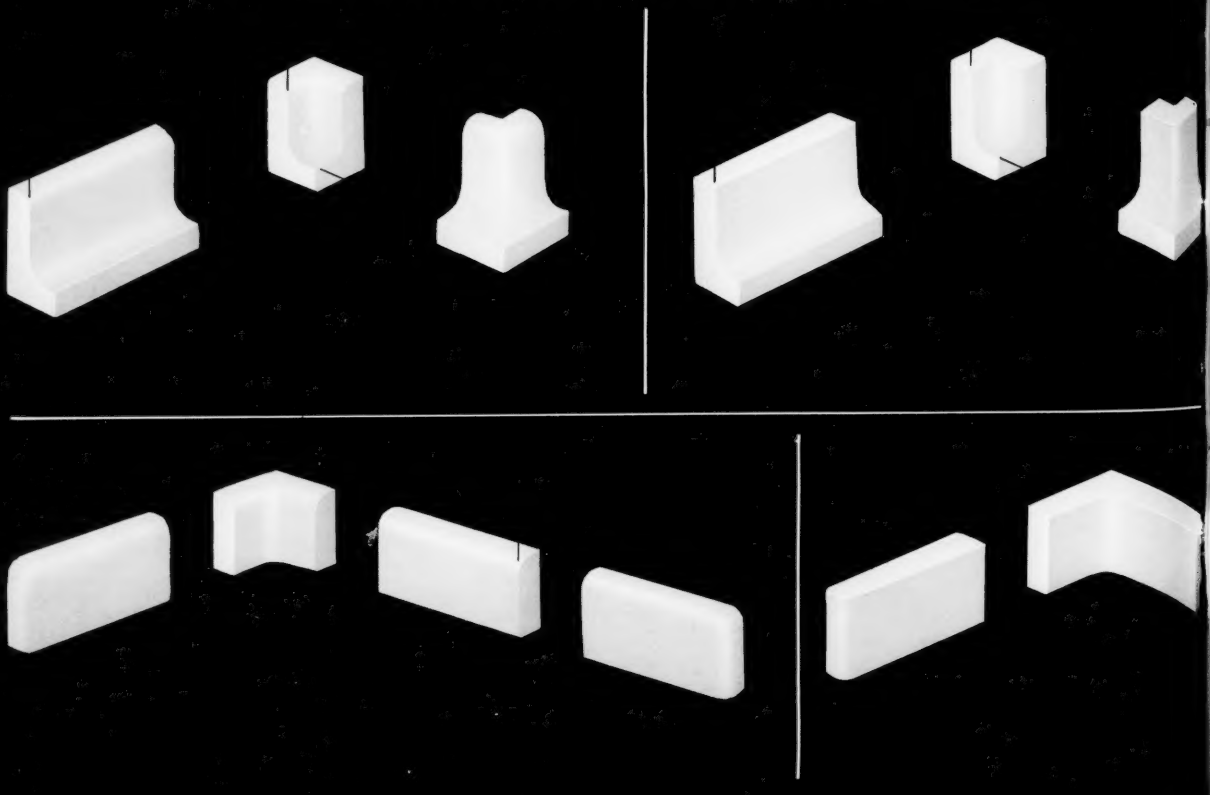
Some typical applications for Duro in acid-proof floors are as follows:

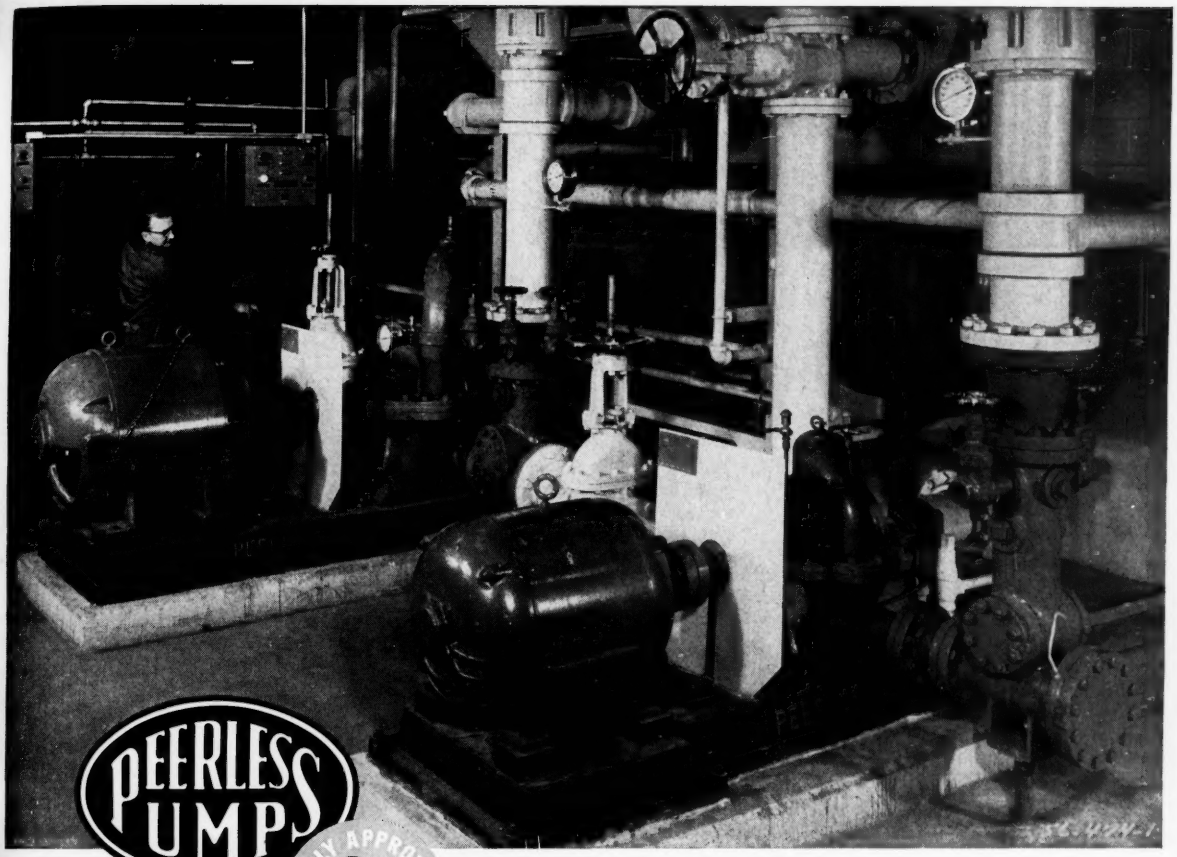
- Acid Rooms
- Bakeries
- Bottling Plants
- Breweries
- Chemical Plants
- Dairies
- Die Works
- Electroplating Plants
- Electrolytic Metal Refineries
- Food Processing Plants
- Galvanizing Departments
- Meat Packing Plants
- Metal Fabricating Plants
- Paper Mills
- Photoengraving Plants
- Rayon Plants
- Steel Pickling Plants
- Textile Mills

HARBISON-WALKER REFRACTORIES COMPANY
AND SUBSIDIARIES
Worlds Most Complete Refractories Service
GENERAL OFFICES: PITTSBURGH 22, PENNSYLVANIA



DIMENSIONS OF STANDARD DURO SHAPES





PEERLESS FULLY APPROVED
FIRE PUMPS . . .

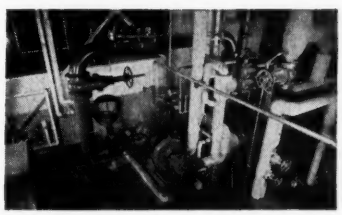
FULLY APPROVED
UL
FM
UNDERWRITERS' LABORATORIES INC. AND ASSOCIATED FACTORY MUTUAL FIRE INSURANCE COMPANIES

Peerless pumps give immediate protection against fire *automatically*, without human attention.

HOW TO DEAL WITH A FIRE BEFORE IT STARTS!

To insure adequate protection against the hazards of fire, a qualified independent fire protection system is a must. And to be doubly sure of the best system, the vital heart of the unit, the pump, should be the best money can buy. That's where Peerless *fully-approved* fire pumps excell.

Throughout a third of a century, Peerless fire pumps have attained an enviable and pre-eminent reputation in protecting all types of buildings, plants and warehouses. Put this know-how to work on your protection problem. See how Peerless' combination of top quality fire pump equipment, exacting engineering application and nationwide service can serve you best. In many instances, the savings effected thru more favorable insurance premiums can pay for the installation. For fire pumps at their very best look to the leader, look to Peerless. Write for bulletin B-1500 today.



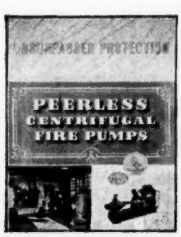
Available with steam turbine, engine or electric motor drives, Peerless fire pumps are available for high pressure sprinkler systems, or foam smothering systems in every kind of commercial, or industrial installation.

Putting Ideas to Work

Peerless Pump
HYDRODYNAMICS DIVISION

fmc
FOOD MACHINERY AND CHEMICAL CORPORATION

Plants:
Los Angeles 31, Calif. and Indianapolis 8, Ind.



Peerless Pump, Hydrodynamics Division, Food Machinery and Chemical Corporation
2005 Northwestern Ave., Indianapolis, Indiana

Gentlemen: Please send me immediately a copy of your Bulletin B-1500.

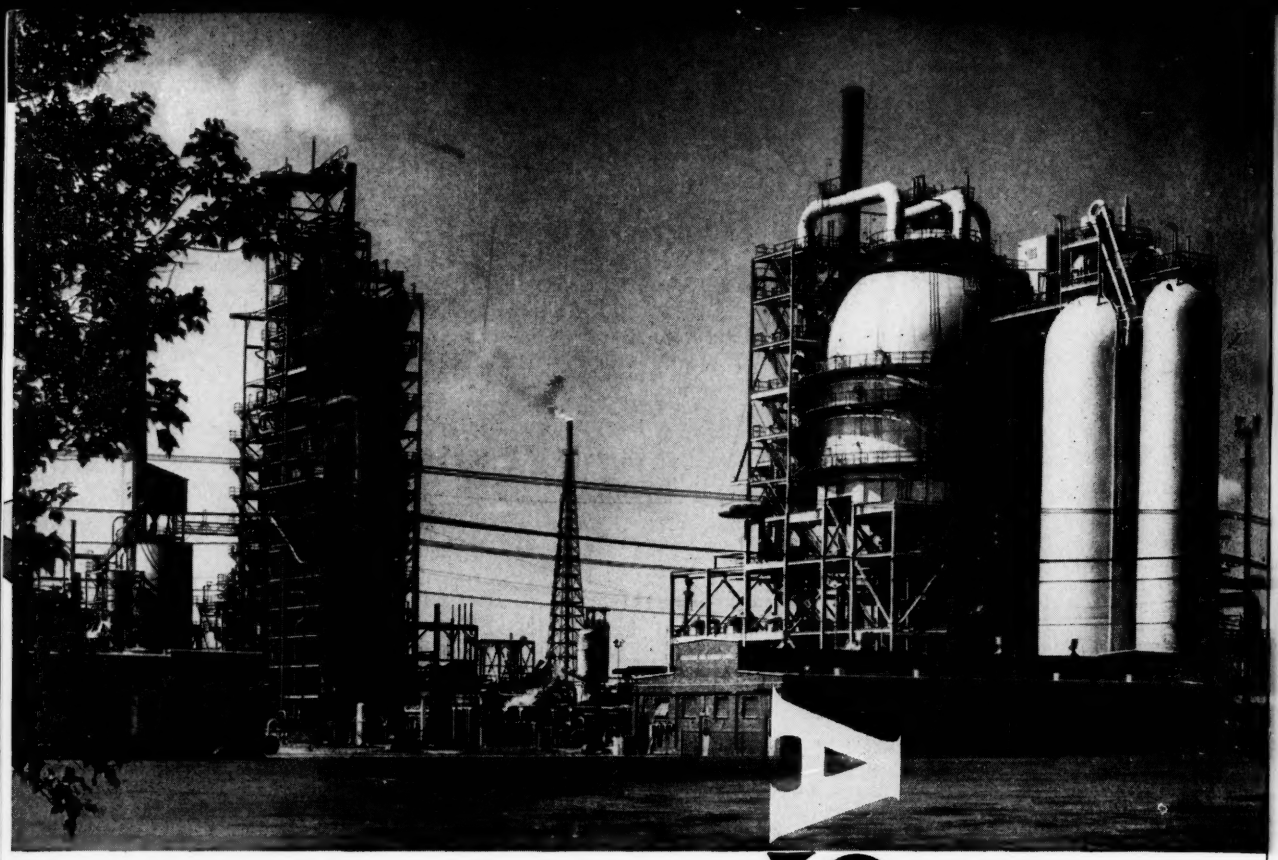
NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

COMING TO THE CHEMICAL SHOW? VISIT US IN BOOTH 831



Low cost, excellent resistance to corrosion:

FEDERATED CHEMICAL LEAD sheet, pipe, fittings, linings

Federated lead products are self-healing; malleable, easy to form and bend; salvable with high scrap value; and probably the most efficient protection you can find for many corrosive chemical conditions. These products include chemical lead sheets to your requirements; pipe, bends, traps and standard fittings available from stock; special forms fabricated to order. Write for Bulletin No. 162, the Lead Handbook for the Chemical Process Industries, to Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York 5, RE 2-9500; or call your nearest Federated sales office.

ASARCO

AMERICAN SMELTING AND REFINING COMPANY

FEDERATED METALS DIVISION

Where to call for information:

ALTON, ILLINOIS
Alton: Howard 5-2511
St. Louis: Jackson 4-4040

BALTIMORE, MARYLAND
Orleans 5-2400

BIRMINGHAM, ALA.
Fairfax 2-1802

BOSTON 16, MASS.
Liberty 2-0797

CHICAGO, ILL. (WHITING)
Chicago: Essex 5-5000
Whiting: Whiting 826

CINCINNATI, OHIO
Cherry 1-1678

CLEVELAND, OHIO
Prospect 1-2175

DALLAS, TEXAS
Adams 5-5034

DETROIT 2, MICHIGAN
Trinity 1-5040

EL PASO, TEXAS
(Asarco Mercantile Co.)
3-1852

HOUSTON 29, TEXAS
Orchard 4-7611

LOS ANGELES 23, CALIF.
Angelus 8-4291

MILWAUKEE 10, WIS.
Hilltop 5-7430

MINNEAPOLIS, MINN.
Tuxedo 1-4109

NEWARK, NEW JERSEY
Newark: Mitchell 3-0500
New York: Digby 4-9460

PHILADELPHIA 3, PENNA.
Locust 7-5129

PITTSBURGH 24, PENNA.
Museum 2-2410

PORTLAND 9, OREGON
Capitol 7-1404

ROCHESTER 4, NEW YORK
Locust 5250

ST. LOUIS, MISSOURI
Jackson 4-4040

SALT LAKE CITY 1, UTAH
Empire 4-3601

SAN FRANCISCO 24, CALIF.
Atwater 2-3340

SEATTLE 4, WASHINGTON
Main 3-7160

WHITING, IND. (CHICAGO)
Whiting: Whiting 826
Chicago: Essex 5-5000

IN CANADA: Federated Metals Canada, Ltd.
Toronto, Ont., 1110 Birchmount Rd.,
Scarborough, Phone: Plymouth 73246

Montreal, P.Q., 1400 Norman St., Lachine,
Phone: Melrose 7-3591

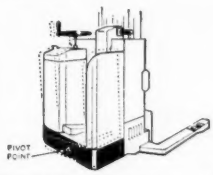
Announcing a

new... ....feature-packed AUTOMATIC® Transveyor

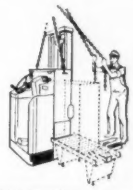
MODEL VST
capacities 2000, 3000, and 4000 lbs.

Here's the narrow aisle truck that sets a new standard for driving ease, serviceability, and lower operating costs. Some of its many features are shown below:

QUADTROL control handle combines speed and lift controls in one unit for easier driving. One handle controls three speeds forward and reverse plus lifting and lowering of the forks.

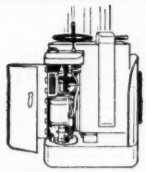


KNEE ACTION FRAME assures stability under all conditions. Straddle arm section pivots independently of drive unit section, preventing frame distortion, lack of traction, and instability on uneven floors.

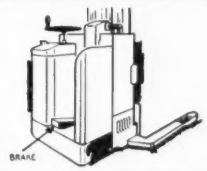


BATTERY REMOVAL top or side. Battery may be rolled out from either side. Steering wheel and Quadtrol controller swing back to allow overhead removal or servicing.

CHANGE FROM AUTOMOTIVE to reverse steering in minutes by changing position of two bolts. Simplifies standardization of steering with rest of fleet.



ACCESSIBILITY of parts simplifies servicing. Rear cover swings out to put drive motor, electrical components and brake within easy reach for servicing.



ELECTRICALLY-INTERLOCKED controls prevent starting or reversing in any but first speed position. Current is disconnected when hydraulic brake is applied.

AUTOMATIC
AUTOMATIC TRANSPORTATION COMPANY
Division of The Yale & Towne Manufacturing Company
155 W. 87th Street, Dept. T1, Chicago 20, Illinois

FIRST IN IMAGINATION / FIRST WITH REALITY

Send for full details NOW!

- ☐ Please send complete specifications and feature data on new Model VST Transveyor.
- ☐ Please send "NEW DIMENSION" booklet which discusses narrow aisle truck applications and available types.
- ☐ Please have your representative call me.

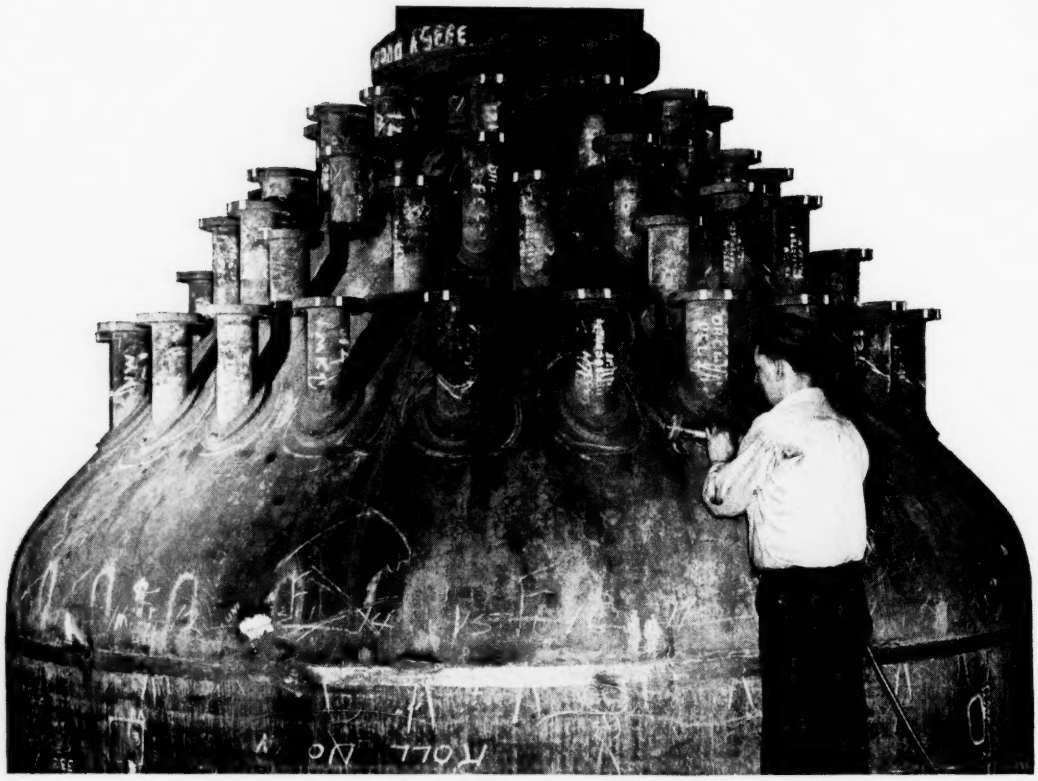
Name_____ Title_____
Company_____
Street_____
City_____ Zone_____ State_____

YOU CAN COUNT ON FABRICATION TO

YOUR SPECIFICATION

WITH PETROCHEMICAL PROCESSING EQUIPMENT

AT NEWPORT NEWS



This reactor cap is made of molybdenum plate. Top courses are 1 13/16" thick and the lower courses are 1 9/16" thick.

Newport News is famous for the painstaking care that goes into every step of the fabrication of heavy process equipment for the petrochemical industry.

A separate, fully equipped shop specializes in the production of all types of pressure vessels and process equipment. Rolls, ovens and other machinery can handle plates up to 5 inches thick. Qualified staffs of engineers and technicians backed up by hundreds of skilled workmen use the most advanced techniques to produce vessels to all specifications. The 225-acre Newport News plant also contains a foundry capable of producing individual castings up to 100,000 pounds, forge facilities that can process units weighing as much as 48,000 pounds and machine shops equipped to mill pieces up to 42 feet in diameter.

Use the men, the methods and the machines of Newport News for your next project. Learn how Newport News can produce your needs . . . on time and to specification. Write today!

Newport News
SHIPBUILDING AND DRY DOCK CO.
NEWPORT NEWS, VIRGINIA

THE BIG NEWS IN VALVES AND FITTINGS IS

DUCTILE IRON!

THE BIG PERFORMANCE LEADER IN DUCTILE IRON IS

STOCKHAM!

Unbeatable performance . . . substantial savings on initial cost . . . lower maintenance costs . . .

These are the three main reasons why engineers throughout the country are now specifying *Stockham* Ductile Iron Valves and Fittings as replacements for steel in many services.

For Stockham's leadership invariably produces the *best* of the *newest*.

Rigid metallurgical control involving continuous tests and analyses assures you superior ductility (far exceeding ASTM specifications) . . . excellent strength (comparable to carbon steel) . . . corrosion resistance (equal to cast iron and 5 to 7 times greater than steel) . . . wear resistance . . . and impact resistance.

These metallurgical superiorities . . . combined with the performance-proven advantages of Stockham's superior design features . . . make Stockham Ductile Iron Valves and Fittings the best and most economical choice for the following RECOMMENDED SERVICES:

—Underground distribution lines . . . brine solutions . . . brackish water . . . ammonia . . . solvent recovery services . . . acids.

—Efficient replacement of cast steel valves in most petrochemical and hydro-carbon processing installations for services up to 650°F.

AVAILABLE NOW!

STOCKHAM DUCTILE IRON VALVES—150 lb. class Globe, NRS Gate, OS&Y Gate, Venturi Pattern Gate.

DUCTILE IRON FITTINGS—300 lb. screwed and 150 lb. class flanged fitting.

See your local Stockham Distributor or write now for new 12-page Ductile Iron Valve and Fitting Catalog giving complete details.

AVAILABLE THROUGH YOUR LOCAL STOCKHAM DISTRIBUTOR

Bronze, Cast Iron, Ductile Iron, Cast and Forged Steel Valves—Wedgeplug Non-Lubricated Plug Valves—Cast Iron, Malleable and Ductile Iron Pipe Fittings.

STOCKHAM
VALVES *and* FITTINGS

General Offices and Plant
4000 10th Avenue, North • Birmingham, Alabama

ONE OF A SERIES OF CHATS ABOUT THE CONSERVATION AND CONTROL OF HEAT

SARCO TOPICS

WHY THE BIG STRAIN?

It's tough to keep gases and liquids "clean" as they run through a pipe. They drag impurities along, which can make even plain water a trouble maker, let alone more sophisticated fluids. That's because water, as a liquid or steam, is intimately involved with vital equipment like steam traps, temperature regulators, or tools. Meters, burners, nozzles, and pumps, too.

By this time you must realize we're going to talk strainers, don't you? A good, stout subject, of interest to all who feel production belongs up and costs belong down. Sarco makes strainers for water and condensate, steam, oil, air, gas and other piped fluids . . . dozens of different sizes and types and ratings of strainers to match every application need. Even our line of plain and simple strainers is built for super service. These are pipeline strainers, types AT, BT, and CT, which are designed for 250, 250 and 600 psi non shock, respectively, and 475°, 450° and 750°F. temperature ratings. Standard screens are heavy-gauge, perforated brass or stainless steel. Sarco specializes in screens that can withstand abnormal pressure differentials created by accumulated sediment.

Next, Sarco's flanged strainers, type D. These come in larger sizes, right up to 12", and are available in standard or extra heavy types.

And finally, *Sarco scraper strainers*, manual or motorized. These are the really eye-popping models, and if you can't use one yourself — well — you'll just have to get your kicks elsewhere.

Examples? Take Inland Steel Company at East Chicago, which gets water from Lake Michigan to cool its large air conditioner condensers. The water used to pass through traveling screens, but still contained fine sand. Clogging!

Heat under collars! Frequent cleaning required! Sometimes practically no air conditioning on hot days. (Isn't that always the way?)

The Inland Steel people installed Sarco Rotary Scraper Strainers, Type VRS, which incorporate a hand-operated helical scraper knife within the cylindrical strainer screen. A few turns of the crank at regular intervals, and the sand is scraped off the screen, blown clear, and discharged at pressure through a manual valve to waste. Dismantle the strainer? Shut down the unit? Not *this* strainer!

Now, as long as we've come this far, it's only a hop and a skip to the Firestone Tire and Rubber Co. in Akron, Ohio, who also use water in tremendous quantities. They circulate it through tire presses and a cooling tower, and there's no nonsense about it. It *has* to be clean or damage to equipment could be downright catastrophic. When the plant

modernized and enlarged, Firestone replaced their 4" Sarco hand-operated scraper strainer, type VRS, with a larger Sarco 8" model. And while they were about it, they got the motor-operated type, for continuous cleaning.

When we say that companies like these want the insurance of a Sarco strainer, it sounds like advertisingese, but sometimes there just isn't any other way to put it. Sarco strainers *are* insurance at low cost on the operation of your high cost equipment. So when we ask if you have lumps in your pumps, or worries over your slurries, we're *serious*. We've heard everything in the straining line, so why not write us for literature and answers to those special problems you have.

A T-44 IS THE BEST POLICY

Sorry, but we can't leave the subject of insurance without bringing to your attention one of the best little insurance policies any company requiring cooling control could invest in. It's the *self-powered* Sarco T-44 Automatic Cooling Control. No compressed air or electricity is needed, but its advantages are best described in terms of three different plants of just one Sarco customer — Revere Copper and Brass, Inc.

Revere-Baltimore, Md., has cut water use 40 to 50% with T-44's. But in addition to former water waste, Revere had even more problems: possible wet air from uncontrolled cooling of compressor aftercoolers, plus sweating compressor cylinders; variations in viscosity of hydraulic oil and bearing oil; gas generator water waste; unreliability of manual shut-off of water supply when machines were down.

If your ears perk up in sympathy at mention of any of these problems, the results of Revere's cooling control program should bring you to full attention. One large compressor that had gulped 2400 gallons per hour now takes only 420 gallon sips. In addition all the problems itemized above were solved. T-44's are now used on their air compressors, gas generators, and hydraulic oil systems. At Revere-Riverside, Cal., water savings of 50% were experienced, and at Revere-Rome, N. Y., substantial savings were made too.

But after all, wasting water is only one way of wasting money, so let's go on to another matter of interest: the evils of manual control. When cooling water is controlled by hand the temptation to leave the valve nearly wide open is almost overpowering, in order to play it safe if the load varies. Result: overcooling, of course. And varying the flow runs the risk of undercooling. In either case, lowered process efficiency. Answer: The automatic Sarco T-44, which can't be tempted, is meticulously honest, unsentimental, and plain inhumanly practical when it comes to cooling control. You really ought to write for literature. T-44 is your best policy.

SPARE PARTS INSURANCE

As long as we're near the end, and still on this subject of insurance, may we graciously leave you with this valuable tip? No matter how closely a steam trap approaches perfection, some gremlin may cause it to act up. It's conceivable. So, keep on hand a parts list and spares of key parts for your steam traps and other system components. Parts are small and worth their weight in gold when you need them. A Sarco field engineer will make up a suggested list for you, if you tell us what components make up your system.

Might as well even keep a disc or two on hand for your Sarco Thermo-Dynamic Steam Traps, Type TD-50, even though they're so trouble-free our salesmen keep complaining about the lack of replacement parts business. We'll be glad to tell you about this unique steam trap in case you still don't know how miraculously simple and effective it is.

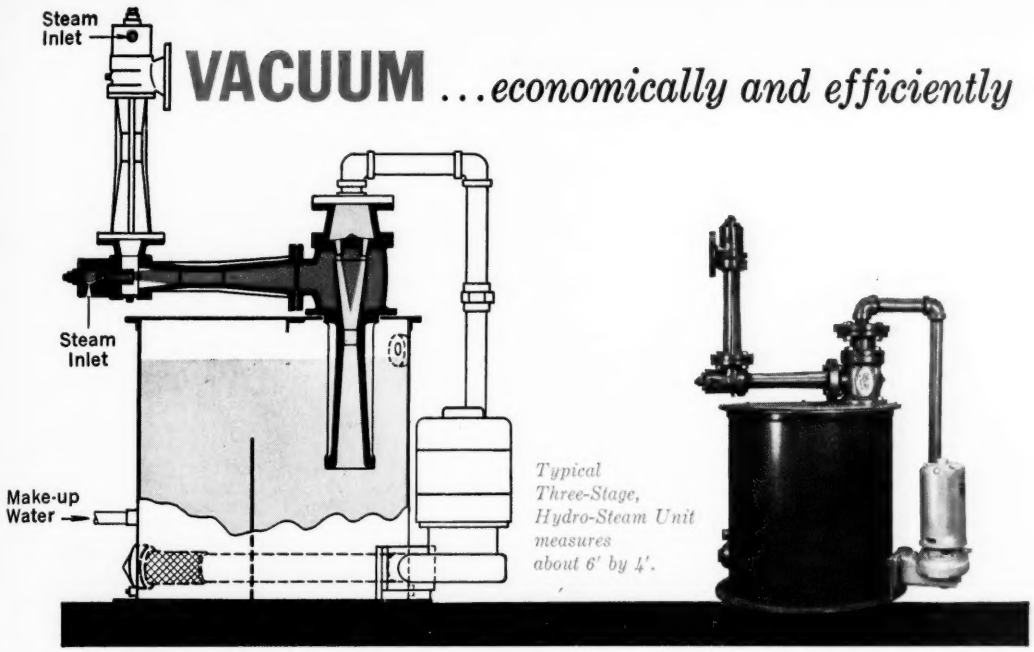
Pardon our monopolizing the conversation in this series of paid communiques, but we're trying our best to interest you in certain subjects that concern us both — to the point where you'll communicate.

5903

SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES



VACUUM ...*economically and efficiently*

Typical Three-Stage, Hydro-Steam Unit measures about 6' by 4'.

SK's Hydro-Steam Vacuum units are compact self-contained vacuum producers that develop any suction pressure down to 25 microns Hg absolute, *economically and efficiently.*

For use in process operations where a sealed system is desired, these packaged units offer specific advantages available in no other type of vacuum pump:

- **low floor space, headroom and piping requirements**
- **low maintenance: jet components have no moving parts**
- **efficient in intermittent *or* continuous use**
- **not affected by contaminants**
- **operate on plant steam**
- **available in single to five-stage types for any suction pressure *from* atmosphere *to* 25 microns Hg absolute**

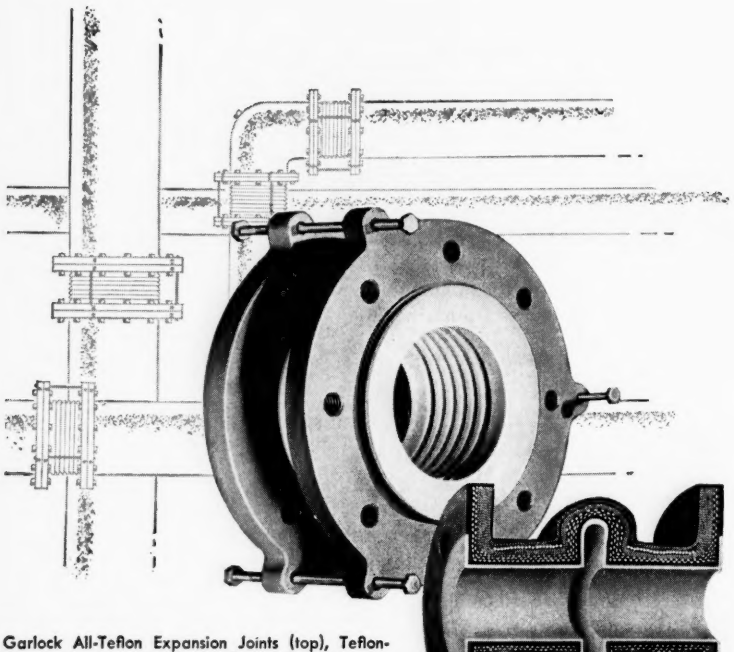
For full information, write for Bulletin 5H-HS.

JET APPARATUS: Ask for Condensed Bulletin J-1.
ROTAMETERS & FLOW INDICATORS: Ask for Condensed Bulletin M-1.
VALVES: Ask for Condensed Bulletin V-1.
HEAT TRANSFER APPARATUS: Ask for Condensed Bulletin HT-1.
GEAR PUMPS: Ask for Bulletin G-1.

Schutte and Koerting
COMPANY
MANUFACTURING ENGINEERS SINCE 1876
2217 State Road, Cornwells Heights, Bucks County, Pa.
Phone: MErcury 9-0900 TWX: Cornwells, Pa. 69-U

ENGINEERED TEFLON PRODUCTS

for Chemical Processing



Garlock All-Teflon Expansion Joints (top), Teflon-lined Expansion Joints (bottom) stop flange breakage, noise vibration . . . correct piping misalignment.

Under constant attack from the most reactive chemicals, Garlock Teflon* Expansion Joints give top protection to expensive piping.

Ideal for fluid process piping handling solvents, acids, and caustics, Teflon Expansion Joints act as a cushion to absorb pump, compressor, engine and pressure surges. This prevents stress, compensates for misalignment, reduces flange breakage . . . your piping lasts longer, your maintenance is cut drastically.

For service to 75 p.s.i., Garlock All-Teflon Expansion Joints are recommended. Consisting of a Teflon bellows with several convolutions, the joints are so designed as to completely shield the flanges; they are furnished with built-in compressible gaskets to contact the face of the metal retaining flanges. No adapters or additional gaskets are required. Garlock All-Teflon Expansion Joints are available in standard sizes for a wide range of pipe diameters and face-to-face working limits.

For service to 150 p.s.i., Garlock Teflon-lined Expansion Joints are suggested. These consist of a spool-shaped Teflon liner backed up by a spool-type expansion joint made of rubber and cotton duck and reinforced with steel rings. The Teflon is made to the same I.D. as the pipe, completely lines the inside of the joint, and is embedded in the joint faces inside the bolt holes. Available for prompt delivery in pipe sizes up to 8″ diameter. Other sizes on order.

For complete pipe protection, Garlock also furnishes All-Teflon Flexible Couplings, and All-Rubber Expansion Joints. For the type best suited to your needs, consult your local Garlock representative. He's at the nearest of the 26 Garlock sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-137, Garlock Inc., Palmyra, N.Y.

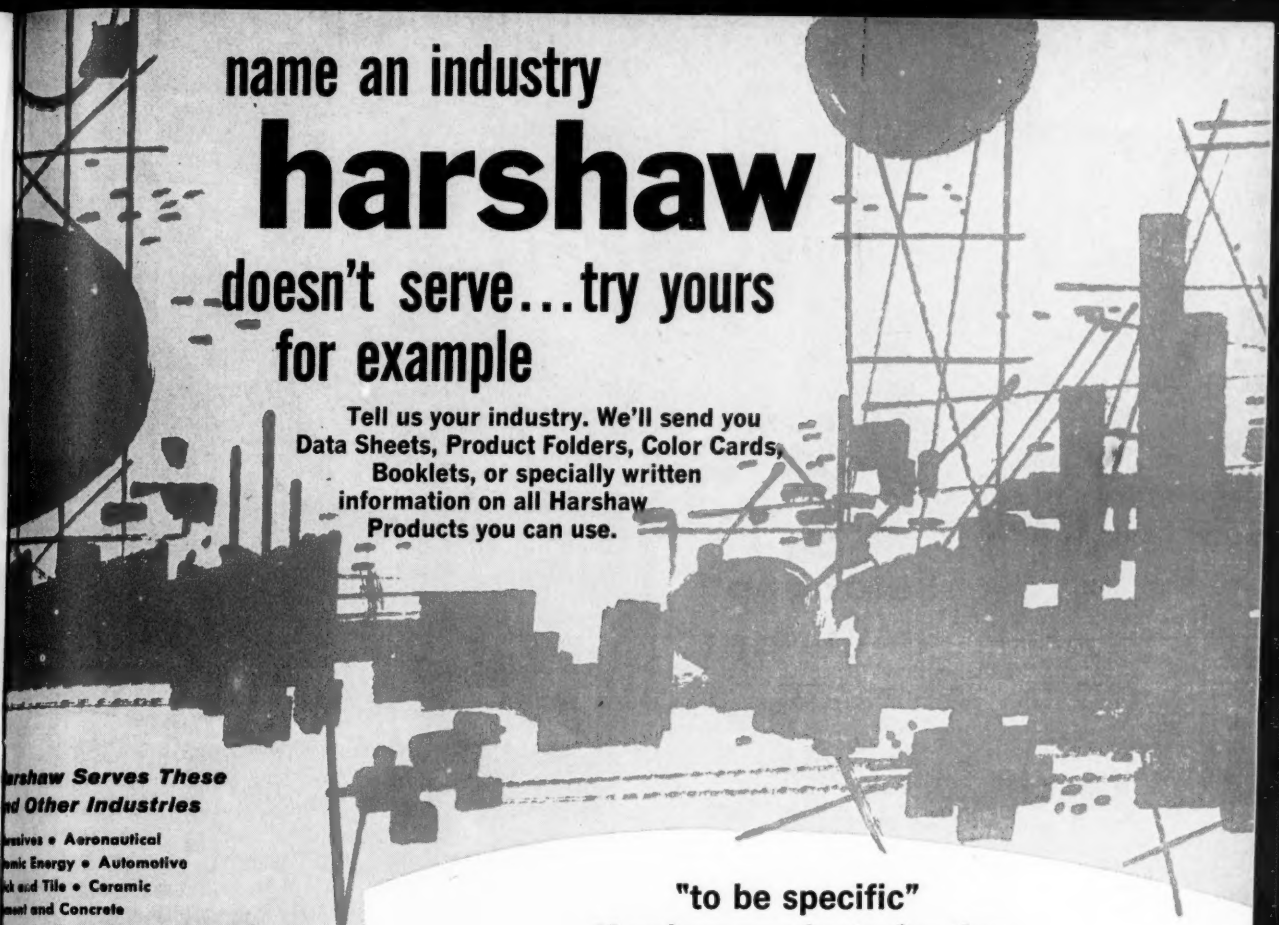
GARLOCK

Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Company

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

*Du Pont Trademark



name an industry

harshaw

doesn't serve...try yours for example

Tell us your industry. We'll send you Data Sheets, Product Folders, Color Cards, Booklets, or specially written information on all Harshaw Products you can use.

arshaw Serves These
nd Other Industries

...esives • Aeronautical
...mic Energy • Automotive
...k and Tile • Ceramic
...ment and Concrete
...mical • Cosmetic
...infectants
...tical Manufacturing
...tronic
...ctroplating • Enamel
...graving and Electrotyping
...plosive • Fat and Oil
...d Stuff, Mineral Feed
...rtilizer • Food
...undry • Glass
...ecticide and Fungicide
...undry • Leather
...thographing
...oleum and Floor Covering
...rfume • Match
...tallurgical • Metal Working
...l Cloth • Optical
...nt, Varnish and Lacquer
...per • Petroleum
...rmaceutical • Photographic
...celain Enamel • Plastics
...dustry • Printing Ink
...rotechnic • Refractories
...ubber • Soaps
...ool • Textile
...lding Electrodes
...ul Paper

"to be specific"
Harshaw products for the

steel industry

HYDROFLUORIC ACID, AQUEOUS—for pickling stainless steel and other alloy steels; for cleaning iron and steel castings.

CATALYSTS FOR: 1. Hydrotreating—clean-up of aromatics and coal-tar fractions. 2. Hydrogenation—saturation of aromatics. 3. Catalysts used in gas atmosphere generators.

SALTS AND OXIDES of Aluminum, Cadmium, Chromium, Cobalt, Copper, Nickel and Zinc for use in specialized treatment of metals.

ELECTROPLATING PROCESSES: Copper, Nickel, Tin, Lead, Lead-Tin Alloy.

ENAMEL OXIDES for porcelain on steel.

SCINTILLATION PHOSPHOR DETECTORS used in tracer studies and thickness gauges.

LABORATORY INSTRUMENTS, APPARATUS, FURNITURE, AND CHEMICALS.

HARSHAW

Harshaw Product Divisions:
...tal Organic Products, Antimony Oxide; Cadmium ...ments and Dispersions; Chrome and Organic Pig...nts; Catalysts; Ceramic Materials; Fluorides; Plating ...ocesses; Anodes and Metal Salts; Stabilizers; Glycer...; Scintillation and Optical Crystals; Textile Products ...l Fine Chemicals; Miscellaneous Organic Products.

...RSHAW SCIENTIFIC FOR LABORATORY SUPPLIES

MAIL TO: THE HARSHAW CHEMICAL COMPANY
1945 East 97th Street, Cleveland 6, Ohio

Send data on Products for the _____ Industry.

Name _____

Company _____

Address _____

City _____ Zone ____ State _____

This is no place for a "stopgap" decision!

For dependable valve performance . . . specify O I C

Hasty "stopgap" decisions may be luxuries you cannot afford. The cost of a valve for essential plant services is very small compared with the high costs of interrupted production, excessive maintenance and early replacement. Specify the valve that is built for complete operational reliability, long life and minimum maintenance.

Play it safe . . . specify O I C. Your nearby O I C distributor has a complete line of bronze and iron valves designed to withstand strain, vibration, shock and pressure changes under many different operating conditions. You make the right decision when you specify O I C.

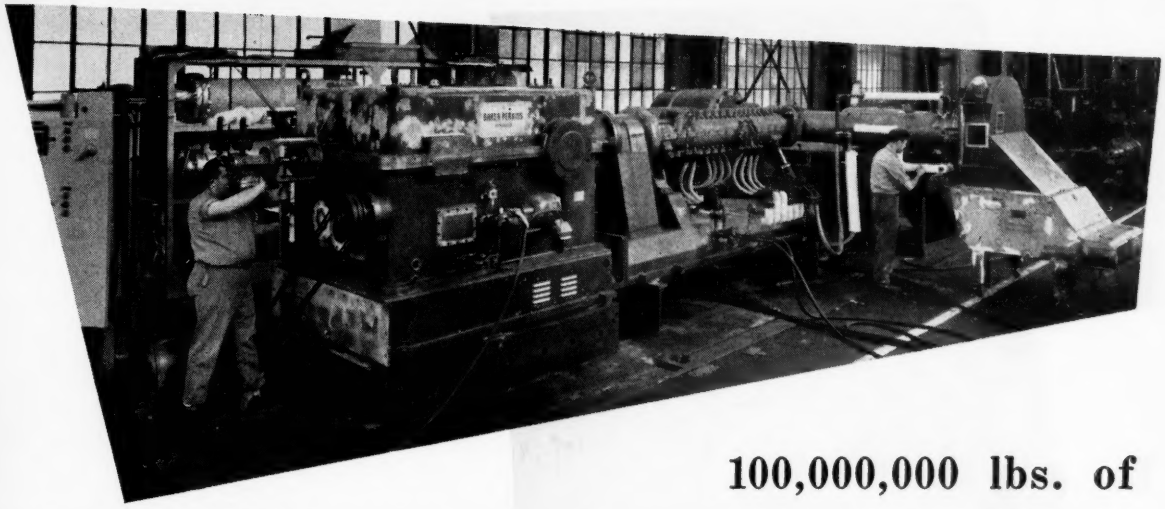
The Ohio Injector Company, 63 Main Street, Wadsworth, Ohio

THE FINEST VALVES AND DISTRIBUTOR SERVICE FROM OIC

INDUSTRIAL DISTRIBUTORS · SERVING INDUSTRY ECONOMICALLY · THE RIGHT HAND OF PRODUCTION ·

OIC VALVES

BRONZE, IRON, FORGED STEEL, CAST STEEL AND DUCTILE IRON VALVES



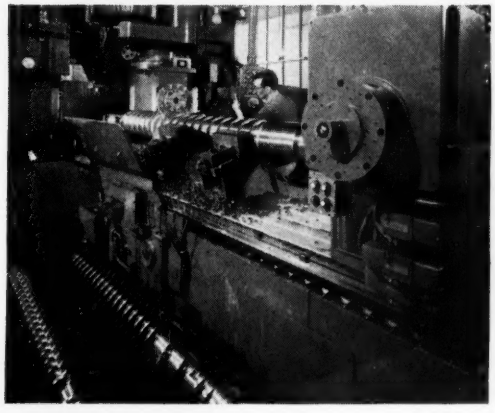
100,000,000 lbs. of POLYOLEFINS PER YEAR WILL BE PRODUCED BY 10 CONTINUOUS PROCESSING LINES NOW BEING BUILT BY BAKER PERKINS

Now all the well known advantages of continuous processing have been adapted by Baker Perkins to compounding polyolefins and other plastics. The operation of each B-P processing line is fully continuous from the feeding of the polymers, pigments, stabilizers and other additives to the discharge of the dried pellets ready for bagging. Each line includes a Force Feeder, *a Ko-Kneader (List System) Continuous Mixer, *a Cross-Head Extruder, *a Hot-Cutting Unit, Water Cooling Trough, Dewatering Conveyor and *Heating and Cooling Unit for the Ko-Kneader and Extruder. Individual lines are designed for 750, 1800, or 3500 pounds per hour.

*These units are shown in top photograph.

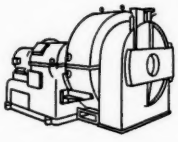
ADVANTAGES OF B-P CONTINUOUS PLASTICS PROCESSING SYSTEM

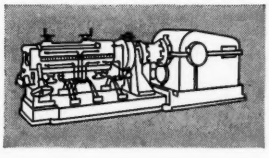
- Improved Product Quality
- Maximum Operating Flexibility—
  Coloring, compounding, venting, modifying, blending and homogenizing can all be accomplished in the same machinery without any alteration.
- Lower Installed Cost—
  Single floor installation
  Uniform power loads minimize electrical wiring requirements.
- Reduced Operating Costs
- Low Maintenance Costs

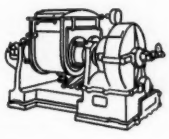


Modern equipment and skilled operators produce the precision components of Baker Perkins plastics processing lines. The operator in the photo above is machining a Ko-Kneader screw on one of the many special purpose machine tools in Baker Perkins shops. Extruder screws are also machined on this same machine. Exacting quality control is maintained in all manufacturing operations at Baker Perkins.

BAKER PERKINS INC.

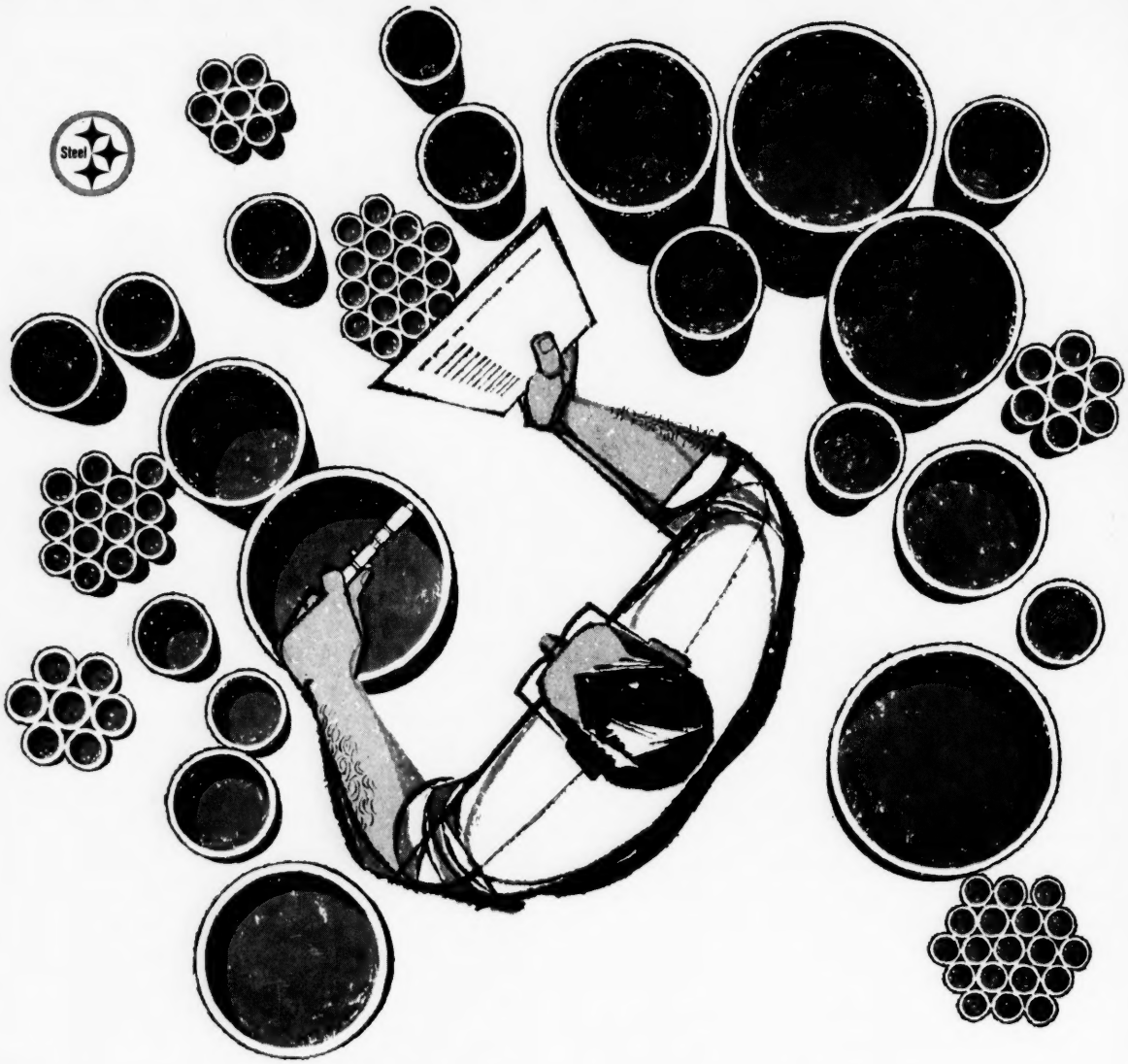






CONTINUOUS CENTRIFUGALS • CONTINUOUS MIXERS • UNIVERSAL MIXERS

SAGINAW, MICHIGAN 407



"Fitness report" with hundreds of identical copies

Armco Steel Corp.
The Babcock & Wilcox Co., Tubular Products Div.
The Carpenter Steel Co., Alloy Tube Div.
Clayton Mark & Co.
Jones & Laughlin Steel Corp., Electricweld Tube Div.
National Tube Div., United States Steel Corp.
Ohio Seamless Tube Div., Copperweld Steel Co.
Republic Steel Corp., Steel and Tubes Div.
Revere Copper & Brass Inc., Rome Mfg. Co. Div.
Sawhill Tubular Products, Inc.
Southeastern Metals Co.
The Standard Tube Co.
Superior Tube Co.
Trent Tube Co., Subs. Crucible Steel Co. of America
Union Steel Corp.
Van Huffel Tube Corp.
Wall Tube & Metal Products Co.

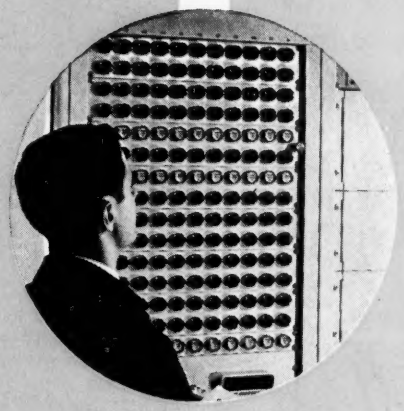
PRODUCES WELDED STAINLESS STEEL TUBE
PRODUCES WELDED CARBON STEEL TUBE

261

Here's the reason why you can count on welded carbon or stainless steel tubing in critical heat transfer applications: its method of manufacture, developed to high domestic standards, results in consistently reliable performance. Starting with clean, scale-free flat rolled steel the resulting tube surfaces are smooth, and free from scratches and pits. You are assured of concentricity, exact O.D. and I.D., precise wall thickness, and uniform ductility for bending or rolling in operations.

Whether you require carbon or stainless steel analyses, listed here are the quality welded tube producers ready to serve you. It will pay you to contact any of them or write for free Booklet 8591, Department CE-5, Welded Steel Tube Institute, Inc., Hanna Building, Cleveland 15, Ohio.

WELDED STEEL TUBE INSTITUTE, INC.



PROCESS PROTECTOR

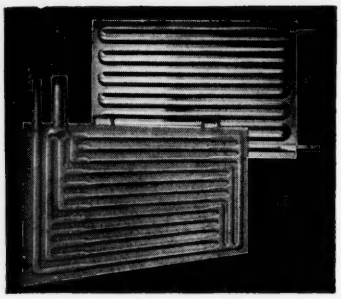
Hagan AIM—centralized monitoring of all important variables

Temperatures, pressures, flows, levels, closures, in fact any input that can be represented by DC voltages as low as 10 millivolts full scale can be monitored by the Hagan AIM (Alarm Indicating Monitor) with an accuracy of plus or minus 0.1% full scale.

Fast and reliable, the Hagan AIM is compact—for example, the readout and alarm panel for 200 alarm points will fit into a 19″ x 47¼″ panel area. Combining all alarm functions in one instrument, AIM can be set for high or low alarm points, or both. Seconds after a monitored variable goes out of bounds, AIM energizes the alarm light and sounds a warning horn. The horn can be shut off, but the light stays lit until the condition is corrected. AIM safeguards both equipment and process from the shattering damage that a single runaway variable can produce. Now *one* man can watchdog a complete process line, taking corrective action before damage is done.

AIM is one component of the complete Hagan line of process controls, which include primary elements, transducers, controllers, recorders and final control elements. Designed for use with existing installations or for complete new systems, the Hagan line can save you money in terms of more accurate control with minimum adjustment and maintenance. For information, write or phone HAGAN CHEMICALS AND CONTROLS, INC., Hagan Center, Pittsburgh 30, Pa.

HAGAN

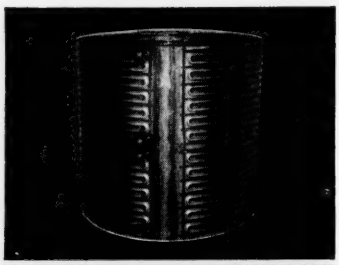


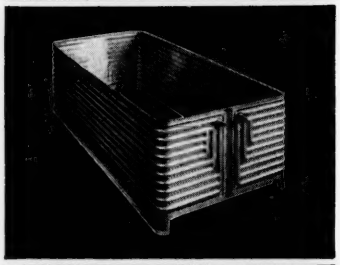
PLATECOIL®

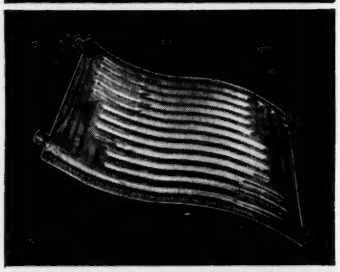
"STANDARD" STYLES OR SPECIALLY FORMED AND FABRICATED

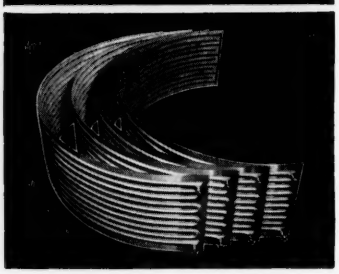
=a SOLUTION

TO DIFFICULT HEAT TRANSFER PROBLEMS









Now you can apply the engineering, installation, operational and maintenance advantages of PLATECOIL to more tank and process heating and cooling problems than ever before. Standard units with exclusive "MULTI-ZONE" pass design for faster heat-up and temperature recovery or serpentine pass arrangement satisfy many requirements. These "standard" styles, available in a wide variety of sizes can be factory-fabricated into banks to fit the application. PLATECOIL can be formed and rolled to specified diameters or even fabricated to form tank walls.

PLATECOIL provides a "packaged" answer to many heat transfer problems, avoiding costly engineering and fabricating of pipe coils. Units are easy to install and maintain—with simple connections, light weight, and streamlined surfaces. High heat transfer capacity permits compact, space-saving units.

Both "standard" and specially built PLATECOIL are available in mild steel, stainless steel, Inconel, Monel, Ni-O-nel, Hastelloy B, C and F, Nickel and other weldable materials. Operating pressures up to 250 psig. Safety factor—5 to 1. Double embossed or one side flat. Complete engineering data and assistance available.

"PLATECOIL" CAN BE FURNISHED TO COMPLY WITH ASME CODE

Ask for Bulletin P61.

Tranter Manufacturing, Inc.

LANSING 9, MICHIGAN

PLATECOIL® DIVISION

. . . more new processing equipment from

FALLS INDUSTRIES, INC.

ANTHONY-DESIGN CONTINUOUS MIXERS

- **provide higher production rates with less equipment**
- **allow proper instrumentation for better process control**
- **reduce overall processing costs**

Fourteen standard models in single or double shaft styles allow wide selection from standards—or specials can be designed to your requirements. Falls Continuous Mixers can handle wet or dry, heavy or light, fine or coarse materials, as well as slurries and abrasives, in capacities from 150 to 200,000 pounds per hour. Produced to code requirements in solid or clad metals or alloys.

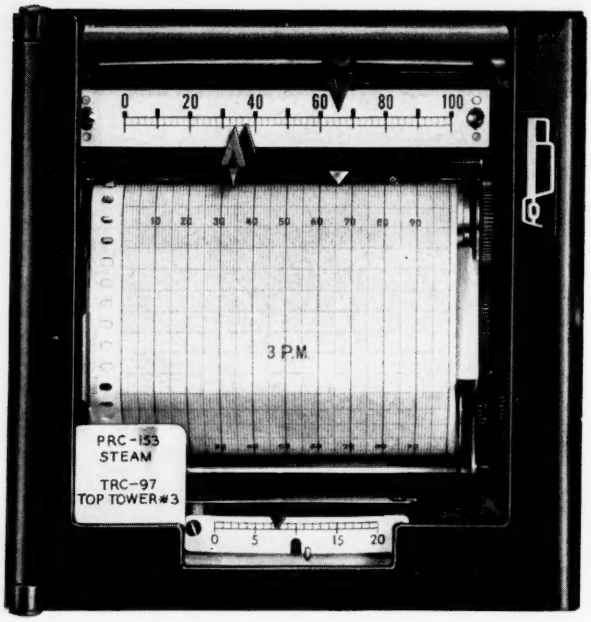
Proven in service—low level of maintenance — high efficiency . . . contact Falls Industries' Engineering Department for specific application data. Catalog available on request.

FALLS INDUSTRIES INCORPORATED

SOLON, OHIO
CHurchill 8-4343
TWX: CGN-FS-720

Producers of New and Improved Processing Equipment

AT THE SHOW
FLOOR NO. 131



New Bristol Series 670 Metagraphic receivers measure only 7" wide by 7⅛" high on panel, come in a wide selection of models, including 1-, 2-, and 3-pen models and models with manual-automatic, manual-cascade, and manual-automatic-cascade control stations.

Now: the USER-PLANNED Receiver

New Bristol Metagraphic

offers you more features for easy installation, flawless operation, and fast, no-down-time servicing than any other 4-inch-chart pneumatic receiver.

At last, here's the ideal pneumatic receiver for graphic panel applications.

It's Bristol's new Series 670 Metagraphic, the receiver with complete plug-in versatility and convenience, plus these new user-designed features:

Simplified control switching between functions—Allows the easiest start-up procedures for automatic or cascade operation. Just adjust process to line up color-coded indicators and switch to automatic or cascade operation as desired.

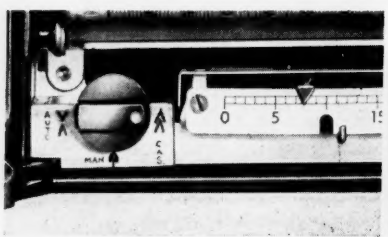
Uniform control switching—All receiver models have the same convenient, easy-to-remember switch positions for the various types of control: cascade position; 3 o'clock; manual position, 6 o'clock; and automatic position, 9 o'clock.

Simplified chart change and inking—Chart changing is a one-hand operation. A new chart can be slipped into place in an instant. The capillary inking system can be filled from the front of the receiver.

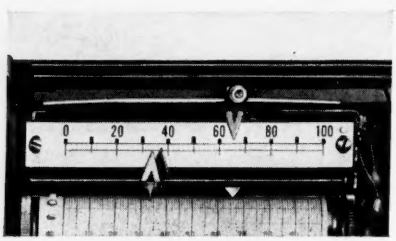
And that's not all: Series 670 gives you such outstanding features as rectilinear chart coordinates for easiest reading, easy connections for any type of control, and sparkless mercury-switch disconnect of electrical circuit when plug-in chassis is withdrawn.

Write for complete data on the new Series 670 today. The Bristol Company, 109 Bristol Road, Waterbury 20, Conn., a Subsidiary of American Chain & Cable Company, Inc. 0.43

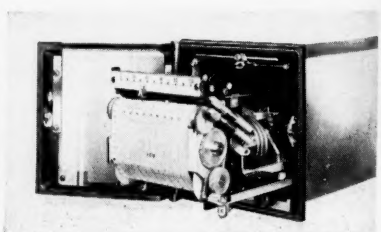
ACCO



Simplified, uniformly-planned control switching facilitates process start-up and operator training.



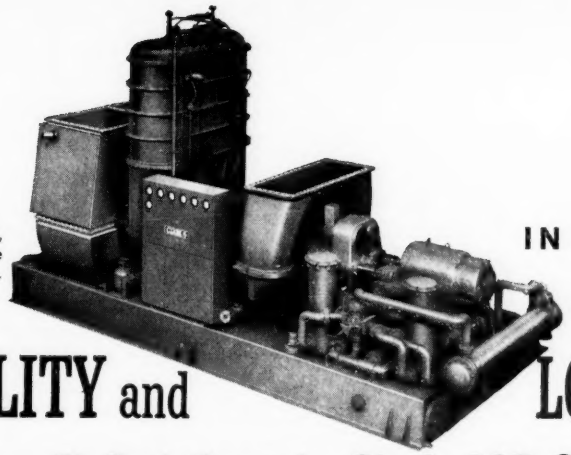
Brightly-colored distinctively-shaped pointers signal process deviation from set-point, even at a distance.



Complete plug-in versatility—long a Metagraphic feature—insures continuity of service.

BRISTOL...for improved production through measurement and control

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS



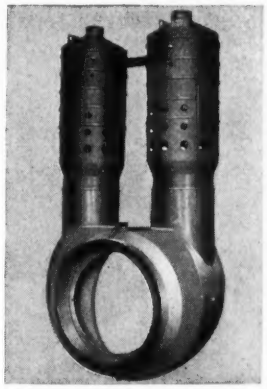
Clark Model 305-S, single shaft gas turbine rated at 9000 hp.

IN GAS TURBINES YOU LOOK FOR

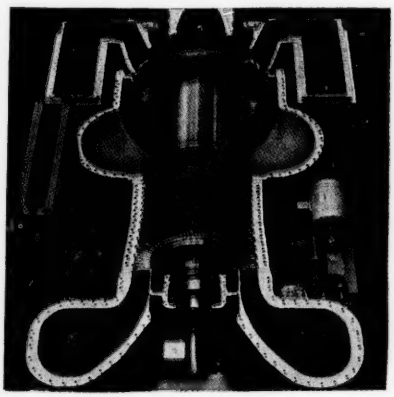
RELIABILITY and LOW FIRST COST

Here's why you'll find them in Clark 305 Series Gas Turbines

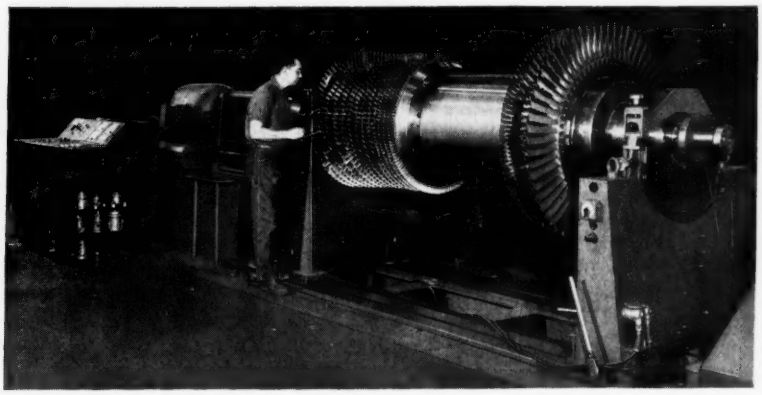
- **Heavy Duty Industrial Design**—Simple, open cycle machines, built for continuous, full load operation . . . ideal drivers for compressors, generators and pumps.
- **Single Shaft Construction**—Provides high rotating inertia and minimum speed variations under transient load conditions. Two-Shaft units available for applications requiring wider operating flexibility.
- **Design Simplicity**—Integral compressor-turbine rotor is supported by two readily accessible journal bearings. Entire unit including combustion system is contained in common casing structure.
- **1400°F Operating Temperatures**—Insure long life of hot parts plus substantial margin of safety.
- **Air Cooled**—Pressurized air cools high temperature components . . . air envelopes minimize heat loss and operating temperatures wherever possible.
- **Vertical Combustion Chamber**—Prevents direct flame impingement on turbine blading . . . assures more uniform heat distribution.
- **Horizontally Split Casing**—Upper half can be removed in one piece to remove rotor . . . inspections quickly made using light lifting equipment.
- **Renewable Labyrinth Seals**—Of honeycomb construction . . . minimize leakage at all close clearance points on turbine shaft.
- **Proved Reliability**—Materials of construction and important components such as turbine blade root design, turbine discs, journal bearings and axial compressor based on broad Clark experience in building heavy duty gas turbines.



Unitized combustion chamber with two parallel burners, each enclosed in a liner of high temperature nickel chrome alloy.



Single rotor is supported by two journal bearings for greatest simplicity. Horizontally split housing provides easy accessibility.



Rotor is statically and dynamically balanced for optimum performance. Turbine blades are of high temperature forged steel. Air streams cool turbine blade roots and both sides of discs.

You are invited to get full details on how Clark 305 Gas Turbines can bring you lower first cost, reduced floor space and installation costs, plus dependable, economical performance. Contact your nearest Clark representative or write for Bulletin 186.

CLARK BROS. CO., OLEAN, N. Y.

CLARK

DRESSER INDUSTRIES INC.

OIL • GAS • CHEMICAL
ELECTRONIC • INDUSTRIAL

FOR EVERY PRACTICAL PURPOSE, this is the best swivel joint in the world. Its design basis is not the product of a limited applicability device, but rather of studied consideration for all applications. It is built to do the best job, with the least maintenance, for the longest period of time. It is a **CHIKSAN** Swivel Joint.

fmc

CHIKSAN COMPANY—General Offices: Brea, California • Well Equipment Mfg. Corp. Division (Weco Unions, Hamer Valves) • Chiksan International • Chiksan of Canada Ltd.
Offices and Representatives in Principal Cities of the World

The conduit that beat 35 years of tough, atmospheric corrosion

For 35 years, beneath the suburban passenger cars of the Illinois Central Railroad, Alcoa® aluminum conduit took the toughest torture Chicago's industrial atmosphere could provide.

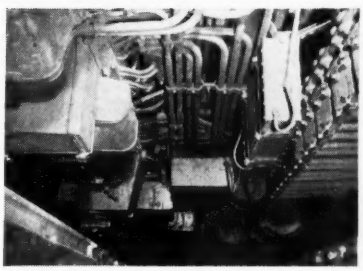
35 of Chicago's blistering summers. 35 of Chicago's blustering winters. Snow. Ice. Rain.

And only the labels were destroyed.

For 35 years this aluminum conduit has been protecting the cars' electrical system, located beneath the cars where they are subjected to most severe service conditions.

The aluminum conduit shrugged off atmospheric attack. Still on the job, it is delivering the same effective protection as the day it was installed.

Perhaps you can benefit from Alcoa aluminum conduit's corrosion resistance, lightness and strength in your plant. Contact your Rome-Alcoa representative, or write Rome Cable Division of Alcoa, **Dept. 22-51, Rome,** New York.

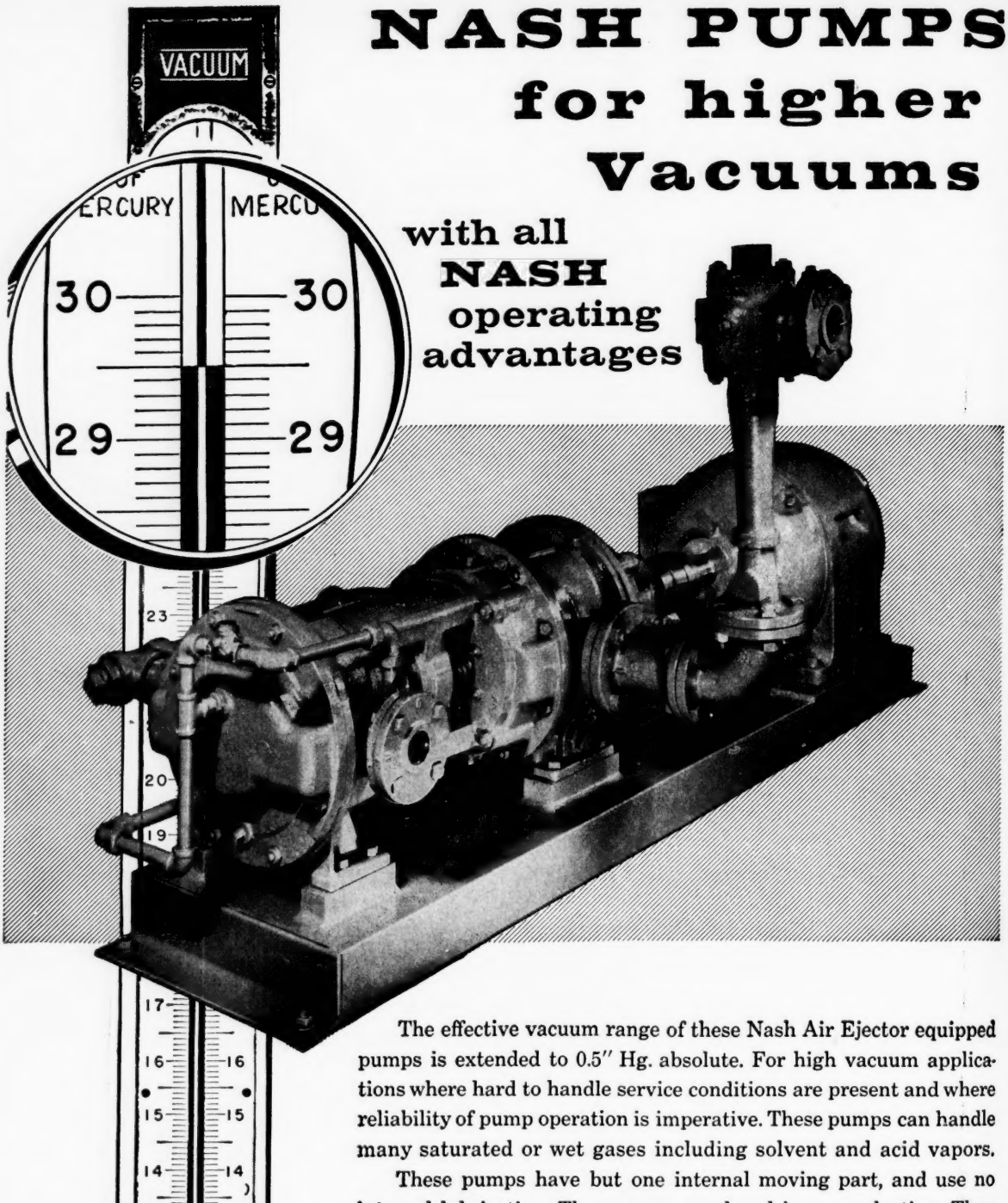


The Alcoa aluminum conduit beneath this Illinois Central car has been in operation since 1926—and only the color has changed.

ALCOA
ROME CABLE
DIVISION

NASH PUMPS for higher Vacuums

with all NASH operating advantages

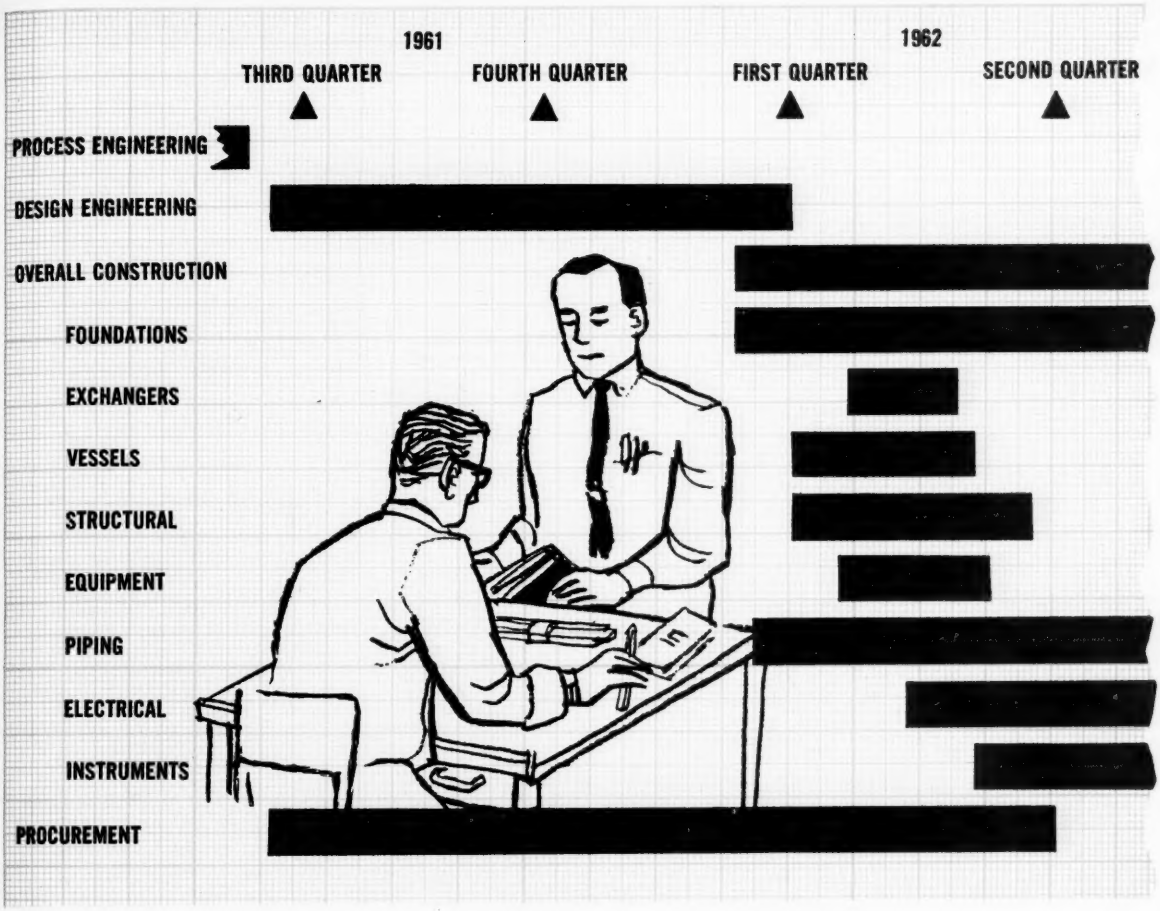


The effective vacuum range of these Nash Air Ejector equipped pumps is extended to 0.5″ Hg. absolute. For high vacuum applications where hard to handle service conditions are present and where reliability of pump operation is imperative. These pumps can handle many saturated or wet gases including solvent and acid vapors.

These pumps have but one internal moving part, and use no internal lubrication. The vacuum produced is non-pulsating. They cannot be damaged by a slug of liquid, and will provide the same reliability and long life even if the operating cycle consists mostly of dead end service. Please request Bulletin 387-A.

NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.



Progress Continues at Kellogg on Monsanto's New Phenol-from-Cumene Plant

The largest phenol-from-cumene plant in the United States is now in the mechanical engineering stage at Kellogg's New York Offices. Designed to produce 75 million pounds per year of high purity phenol, plus large quantities of acetone, the plant will be built at Chocolate Bayou, Texas, for Monsanto Chemical Company.

Full responsibility for engineering, procurement, and construction has been assigned to The M. W. Kellogg Company. A major portion of the process design is based on information licensed from Hercules Powder Company.

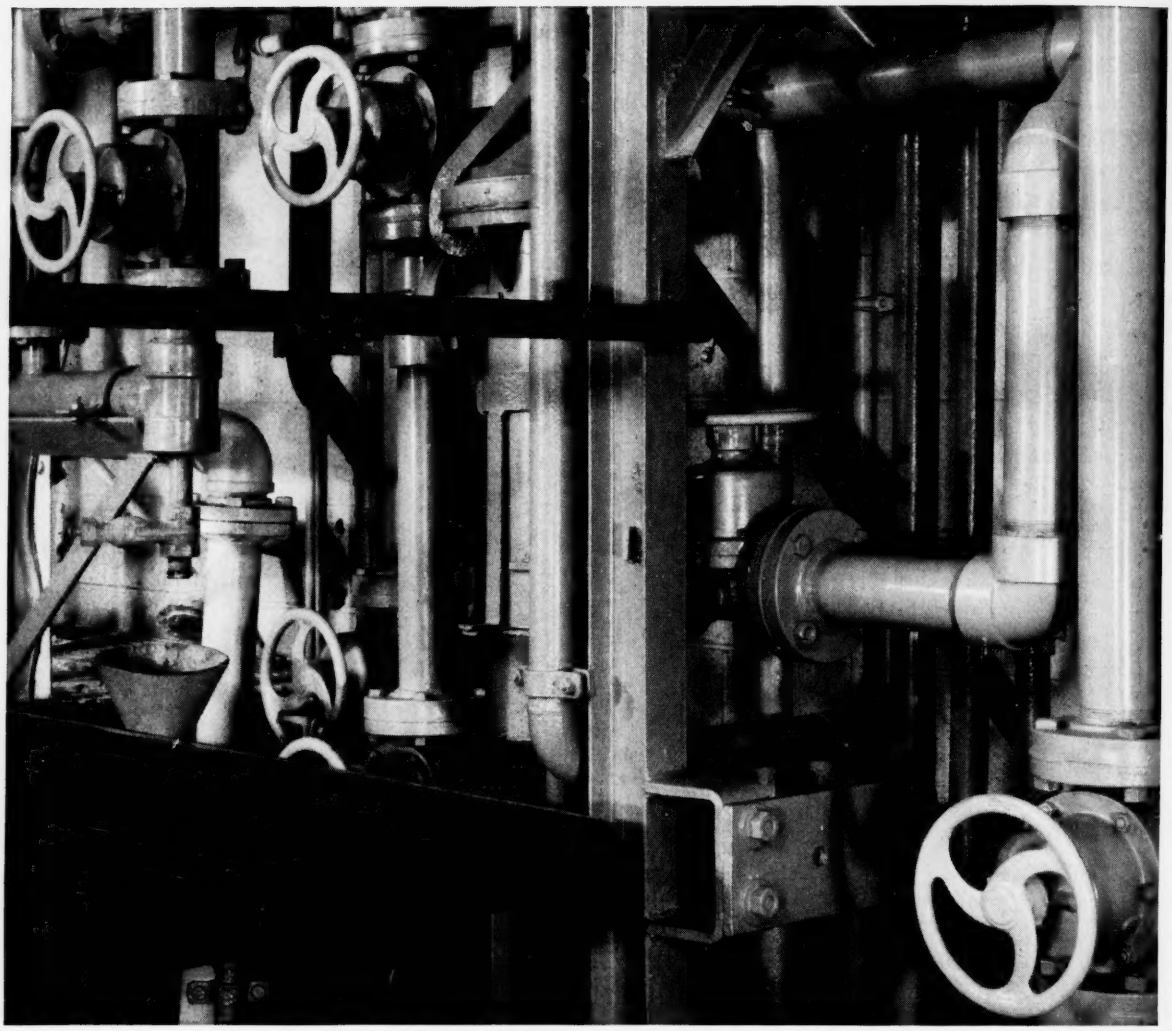
Feeds to the cumene section will be benzene and propylene; both will be produced by Monsanto at Chocolate Bayou. Feeds to the phenol section will be cumene and air. The entire project, part of the huge multi-million-dollar chemical complex Monsanto is building at Chocolate Bayou, is scheduled for completion in the summer of 1962.

Kellogg-Monsanto teamwork at Chocolate Bayou is another example of Kellogg's active participation in helping chemical, petrochemical and refining companies achieve their broad investment goals. To obtain information on how the Kellogg organization can translate your new-plant investment into the finished plant, you are cordially invited to contact The M. W. Kellogg Company.

THE M. W. KELLOGG COMPANY

711 Third Ave., New York 17. *A subsidiary of Pullman Incorporated*

The Canadian Kellogg Company, Ltd., Toronto
Kellogg International Corporation, London
Societe Kellogg, Paris
Kellogg Pan American Corp., Buenos Aires
Compania Kellogg de Venezuela, Caracas
Companhia Kellogg Brasileira, Rio de Janeiro



Grinnell-Saunders Straightway Valves* on duty 3 years in pioneer bleach-liquor process.

In world's first continuous, automatic
ORP controlled-reaction $Ca(OCL)_2$ process . . .

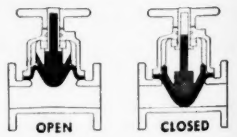
Grinnell-Saunders Diaphragm Valves mark third year of trouble-free service

3 years ago, the world's first continuous, automatic semi-clarified calcium-hypochlorite process—using oxidation-reduction-potential control of reaction — went on stream at Crown Zellerbach's St. Helens, Ore. mill. Selected to control materials-flow in this pioneer installation: Grinnell-Saunders Diaphragm Valves.

Today, Crown Zellerbach reports that the Grinnell-Saunders Diaphragm Valves still give trouble-free service even after 3 years of handling highly-corrosive bleach-liquor!

Grinnell-Saunders Diaphragm Valves offer streamline flow — leak-tight closure — easy maintenance. Working parts are completely isolated from material in the line to prevent corrosion, abrasion, clogging. Wide choice of body, lining and diaphragm materials, too.

See how Grinnell-Saunders Diaphragm Valves can help *your* installation. Write or call Grinnell Co., Providence 1, Rhode Island.



GRINNELL COMPANY, PROVIDENCE 1, R. I. • BRANCH WAREHOUSES AND DISTRIBUTORS FROM COAST TO COAST
PIPE FITTINGS • VALVES • PIPE HANGERS • PREFABRICATED PIPING • UNIT HEATERS • PIPING SPECIALTIES

Delivery on the double

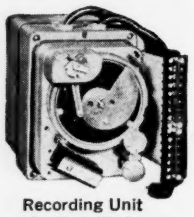
Phone us today—and our modern, stainless-steel tank trucks will arrive at your plant tomorrow with your order of pure, uncontaminated "Elastex" Plasticizers. Whether you want quality plasticizers for rubber, plastics or coatings, the Plastics Division can give you what you need plus an assurance of the highest purity and uniformity. For dependable, next-day delivery, make sure you call the office nearest your plant.

ALLIED CHEMICAL ELASTEX® PLASTICIZERS

Boston . . . . DAvenport 2-7460
Buffalo . . . . . TR 3-3600
Chicago . . . . MIchigan 2-1800
Cleveland . . HEnderson 2-2020
Detroit . . . . . VInewood 2-2500
Houston . . . . . WAlnut 3-2871
Indianapolis . . . CLifford 5-5443
Los Angeles . . . NEvada 6-2306
New York . . . . HAnover 2-7300
Newark . . . . . MItchell 2-0960
Philadelphia . JEfferson 3-3000
St. Louis . . . PLainview 6-3404

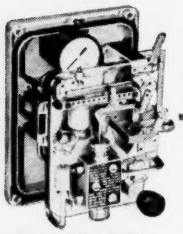
PLASTICS DIVISION
40 RECTOR STREET, NEW YORK 6, N.Y.

Allied Chemical
BASIC TO AMERICA'S PROGRESS

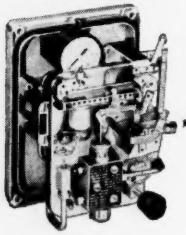


Recording Unit for Variable 1

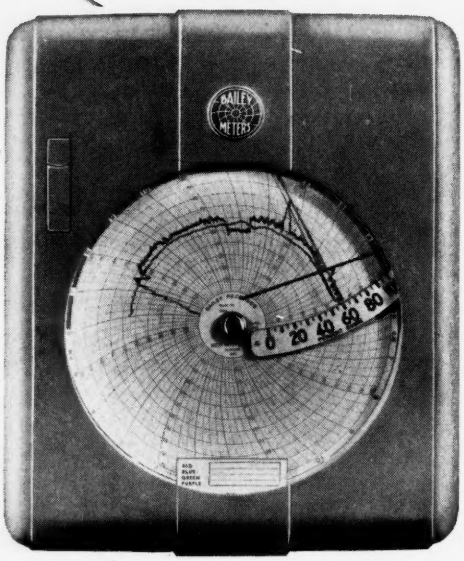
Recording Unit for Variable 2



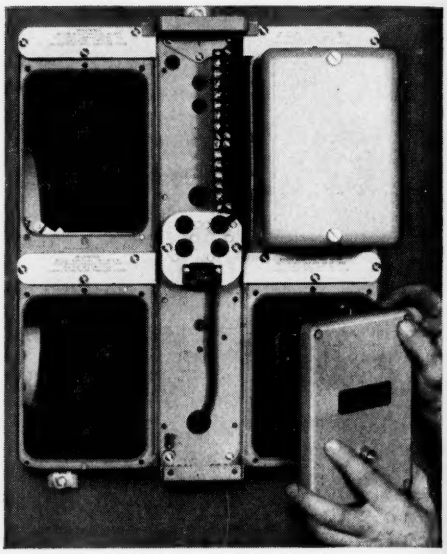
Controlling Unit for Variable 1



Controlling Unit for Variable 2



Back of Bailey Recorder, showing how four plug-in units may be added as needed.



Key to "step-by-step" automation . . .

BAILEY RECORDERS

with plug-in flexibility

When you are pioneering a new process and don't know all the answers, complete automation is seldom practical. The first step is to identify your variables and measure them. Nothing does this job better than a Bailey Recorder. One instrument can record any four variables that can be converted to electric *or* pneumatic signals.

Then you will want to add controls and feed back your measurements. Here's where the versatility of the Bailey Recorder comes into play. For the same Bailey instrument you use to record variables is designed to accommodate plug-in control units.

When you use a Bailey Recorder, you can build your instrumentation along with your process. At the start, you use only the plug-in units for recording. Then you add plug-in controls as you see the need for them.

For the complete story of how you can use a Bailey Recorder for step-by-step automation, contact your local Bailey Engineer.

CP111-1

Chemical and petroleum division

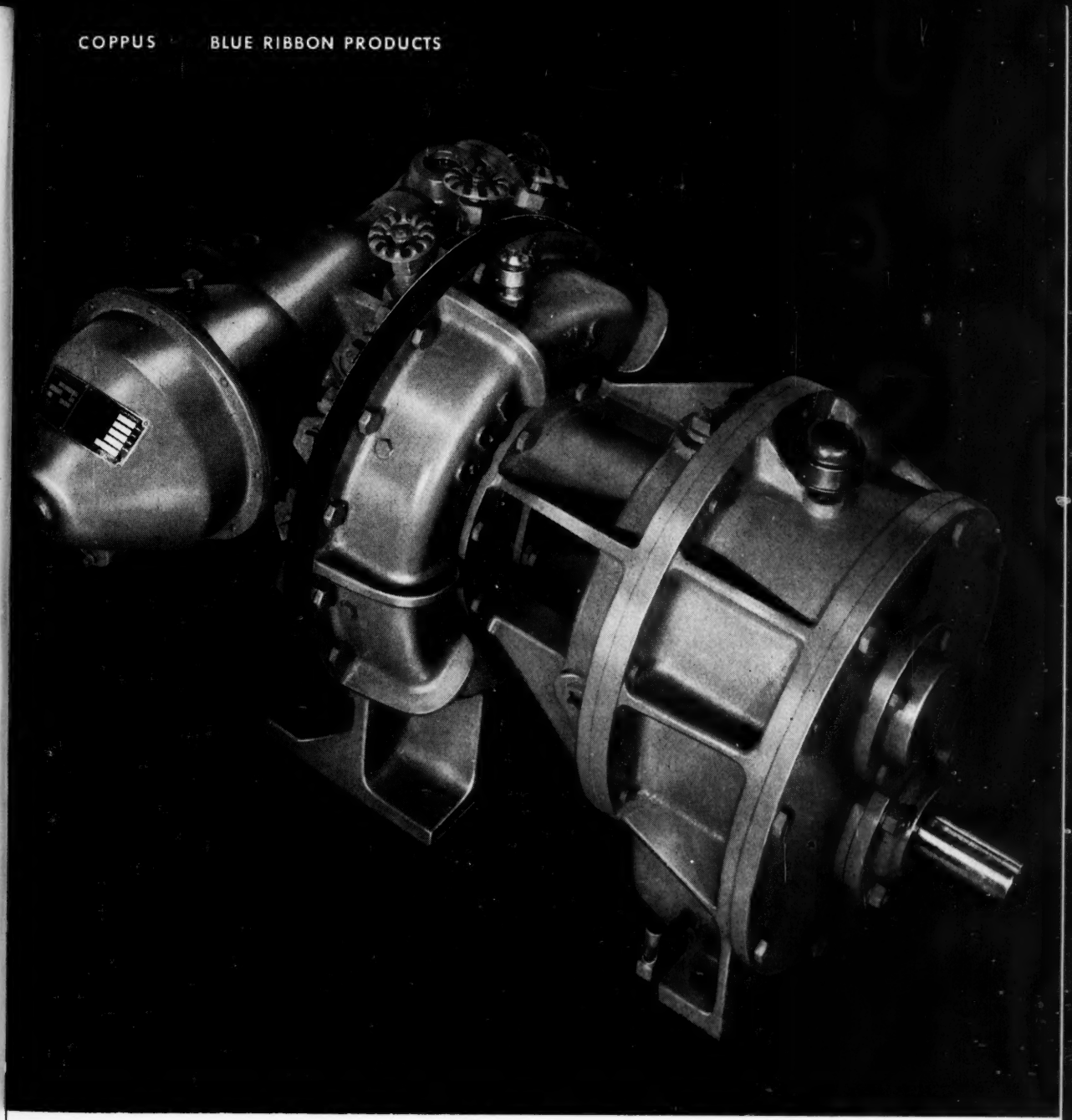
BAILEY METER COMPANY

1054 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada---Bailey Meter Company Limited, Montreal

BAILEY METERS

COPPUS BLUE RIBBON PRODUCTS



Coppus Steam Turbine with Built-In Speed Reducer

STAMINA — You can literally *see* stamina in every dimension of a Coppus Turbine . . . rugged reliability that assures you stable, positive performance. It truly "wins" the Blue Ribbon with which it is marked . . . through advanced design, top quality materials, and thorough testing. With Coppus you're always certain of Blue Ribbon features such as these —

A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. Sizes from 1 HP to 250 HP. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, 230 Park Ave., Worcester, Mass. Sales Offices in *Thomas' Register*.

COPPUS
STEAM TURBINES

Please don't feed the "TUBE EATERS"

Don't let unnecessary pitting, cracking or erosion chew up tubes before their time. Don't let *any* type of corrosion, scale or biofouling hamper your heat exchange efficiency without checking these four factors:

● Is the tube alloy *right?* Will a vital difference in corrosion resistance result from a minor alloy change—or is an entirely different alloy called for? ● How much will performance be improved by Duplex bi-metallic tubes which provide the best metal or alloy for *each* heat transfer medium. ● Will a change to thickened-end or thickened-center tubes give needed extra resistance where attack is most severe? ● What actual data on similar exchanger operations are available?

We at Bridgeport can help you. Our condenser tube experience dates back to 1900 but our files are completely up-to-date on tube problems reflecting the high pressures, temperatures and velocities of modern operations. Write Bridgeport Brass Company, Bridgeport 2, Connecticut.

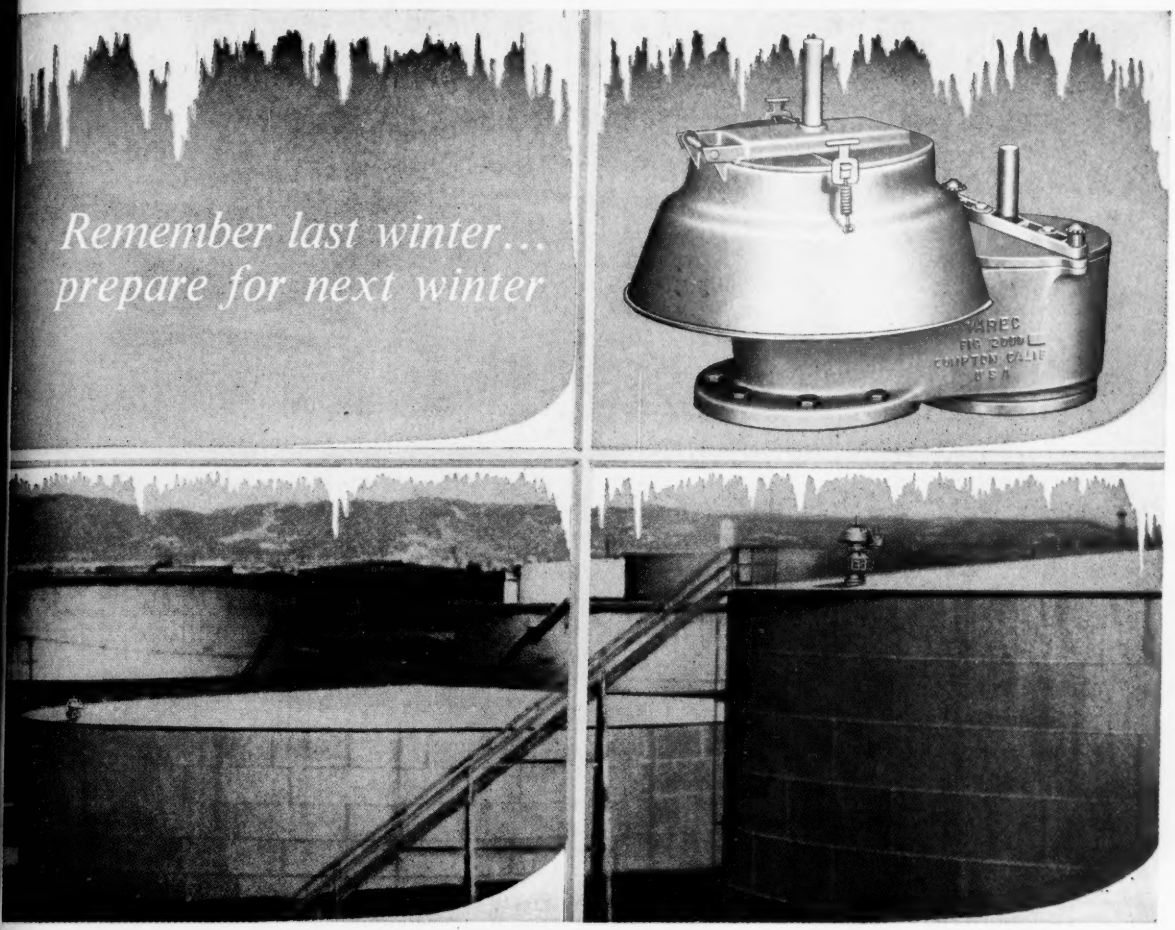
Bridgeport condenser and heat exchanger tubes in over 50 metals and alloys:

INHIBITED ADMIRALTY
INHIBITED ALUMINUM BRASS
INHIBITED MUNTZ METAL
70-30 CUPRO NICKEL
90-10 CUPRO NICKEL
DEOXIDIZED ARSENICAL COPPER
INHIBITED ALUMINUM BRONZE
RED BRASS
ALLOY 77 MERCURY BRASS

...plus **DUPLEX TUBES**...in combinations of the above alloys, with carbon or stainless steel, aluminum, Monel,® nickel...or other metals.

BRIDGEPORT BRASS COMPANY

Bridgeport



MODERNIZE YOUR TANK FARM NOW

with the new Varec All-Weather Breather Valve that works perfectly in -60° winters and +125° summers.

Here's all-weather performance that's been *proven* through two full years of Eastern Canada's roughest climate... frigid winters... hot, humid summers. Yet never once did Varec's rugged new Fig. 2000-61 ALL-WEATHER Breather Valve fail to operate perfectly. What's more, this petro-chemical plant can look forward to the continuation of this 100% performance for many tough seasons to come.

By modernizing your tanks with this new Varec ALL-WEATHER Breather Valve, you are now assured of tank safety and vapor saving efficiency *the year around.*

NEW FIG. 2000-61 MODEL... TWO-WAY PROTECTION AGAINST FREEZE-UP.

Here's how Varec engineers have solved the cold-weather problem: First, both pressure and vacuum pallets utilize a flexible diaphragm of special non-frosting, icing-resistant material. This eliminates possible freezing between pallet and seat ring.

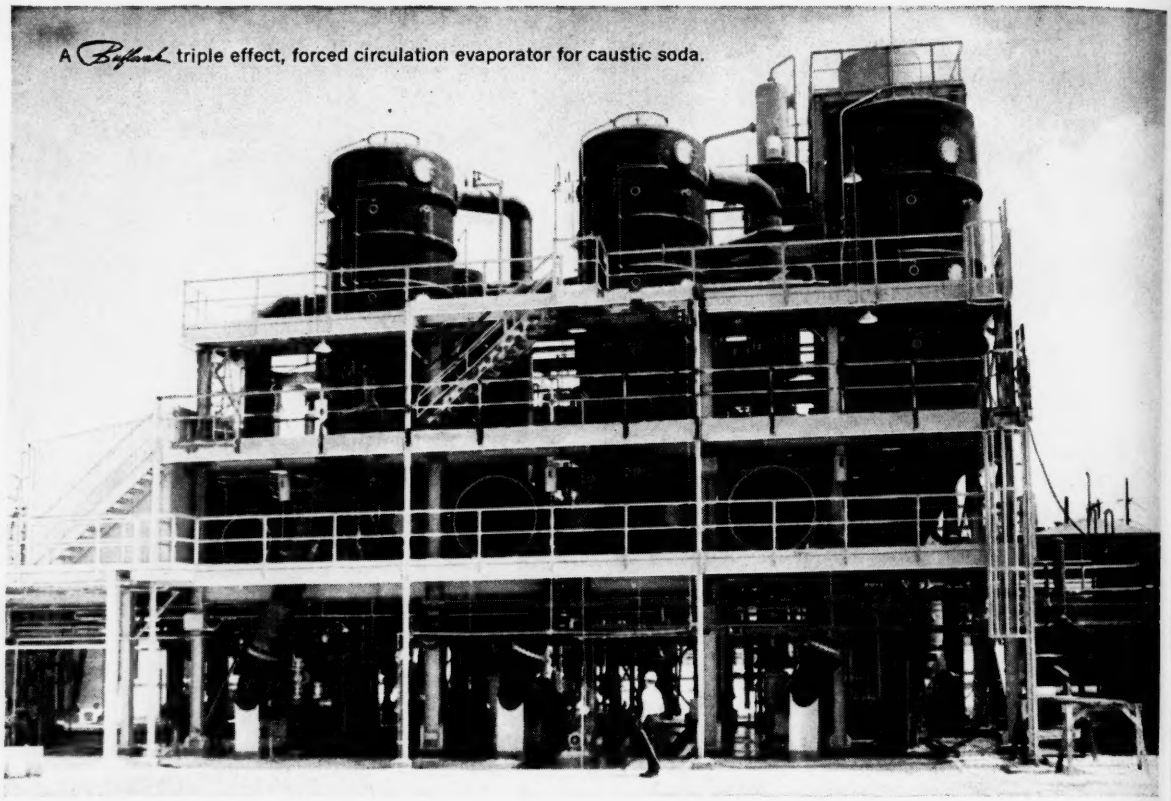
Second, a special non-frosting, icing-resistant compound is used to coat the pallet perimeter and stem, guide-posts and tip of seat ring. Ice and snow scrape free when the pallet lifts.

For complete information on the Varec Fig. 2000-61 ALL-WEATHER *Breather Valve, write for Varec Bulletin No. CP-2701, Dept. CHE-1644-1*

"Varec"
TRADE ® MARK

THE VAPOR RECOVERY SYSTEMS COMPANY
2820 North Alameda Street · Compton, California

Branches and Representatives in Principal Cities



A Buflovak triple effect, forced circulation evaporator for caustic soda.

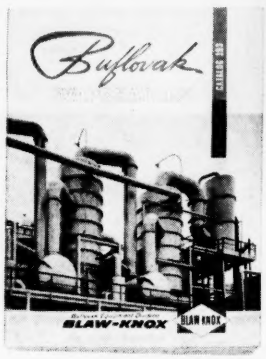
If evaporation is your problem... Buflovak can furnish the right answer

No one type of evaporator can solve all problems profitably. But Buflovak is not limited to one type. Only Buflovak makes six basic types of evaporators for the largest selection in the industry. They are:

Rising Film (VRC)
Forced Circulation (FC)
Falling Film (Downflow)
Agitated or Wiped Film (Roto-Vak)
Rising-Falling Film (RFC)
Calandria

Our Customer Technical Service Laboratory is equipped with each of these and can test your material or check your process on any or all of them. The results will indicate which evaporator or combination of equipment will solve your problem most economically.

We have helped hundreds of other companies with their processing problems. We can help you, too. Buflovak Equipment Division, 1551 Fillmore Avenue, Buffalo 11, New York.



New Evaporator Bulletin

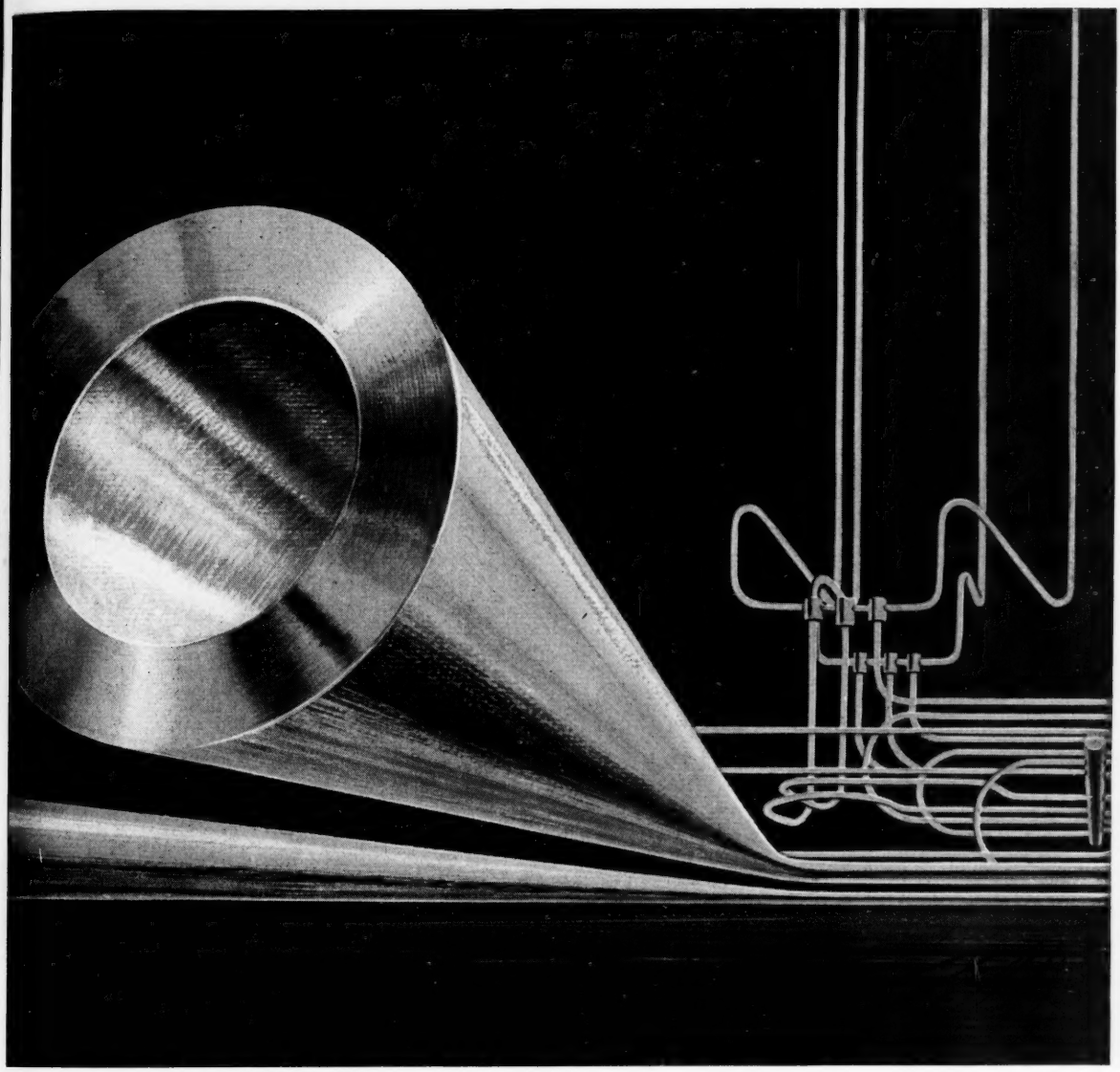
Write for your copy of the new Buflovak Evaporator Bulletin, No. 393, describing basic evaporator types and how they are used.

Buflovak Equipment Division

BLAW-KNOX

BLAW-KNOX

Blaw-Knox designs and manufactures for America's growth industries: METALS: Rolling Mills • Steel Processing Lines • Rolls • Castings • Open Hearth Specialties • PROCESSING: Process Design, Engineering and Plant Construction Services • Process Equipment and Pressure Piping • CONSTRUCTION: Concrete and Bituminous Paving Machines • Concrete Batching Plants and Forms • Gratings • AEROSPACE: Fixed and Steerable Antennas • Radio Telescopes • Towers and Special Structures • POWER: Power Plant Specialties and Valves



How to handle super critical steam at 100 m.p.h.

Today's modern power generating plants demand superheater tubes and piping that must meet the highest pressure-temperature combinations ever achieved with steam. The Timken Company is supplying these tubes—stainless steel pressure tubes. In fact, we've produced tubes made from a special steel never before successfully pierced—until our experts did it.

Timken® stainless steel pressure tubes are the answer to many high temperature-pressure problems because we use special techniques, unique in the industry, to keep physical and chemical composition uniform. And you can select from a wide variety of sizes and analyses, many available from only the Timken Company.

Let Timken Company metallurgists help you solve your tough steel problems. They're acknowledged experts in their fields. They'll work with you to select the stainless steel pressure tube to suit your needs and give you your money's worth.

Call or write: The Timken Roller Bearing Company, Canton 6, Ohio. Cable: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

TIMKEN® *Fine Alloy* STEEL

TIMKEN ALLOY STEEL AND SEAMLESS STEEL TUBING ARE AVAILABLE FROM STEEL SERVICE CENTERS IN MORE THAN 40 CITIES IN THE UNITED STATES

Call on us at the National Metal Exposition, Cobo Hall, Detroit, October 23-27, Booth 739.

The specialists at General American's Kanigen plant in Sharon, Pennsylvania can deposit an even coating of hard nickel alloy on most ferrous metals in common use. Regardless of how high, wide or heavy the object is, if you can get it to Sharon, we can plate its interior.

Before General American developed Kanigen coating, it was next to impossible to deposit an even nickel plating over very large surfaces or on many complex shapes. Since Kanigen nickel plating is purely a chemical process involving no electric current, it works equally well on simple or complex shapes and on small or large surfaces. Thickness uniformity of the coating is independent of part complexity or size.

Only General American and its authorized licensees around the world can show you how Kanigen coating may improve your product. The Kanigen process is protected by more than 30 separate patents. For detailed technical literature, write for bulletin No. 561.

IF YOU CAN SHIP IT WE CAN PLATE IT!

NO MATTER WHAT THE SIZE OR SHAPE OF YOUR PRODUCT, IT CAN BE COATED BETTER WITH KANIGEN® NICKEL ALLOY

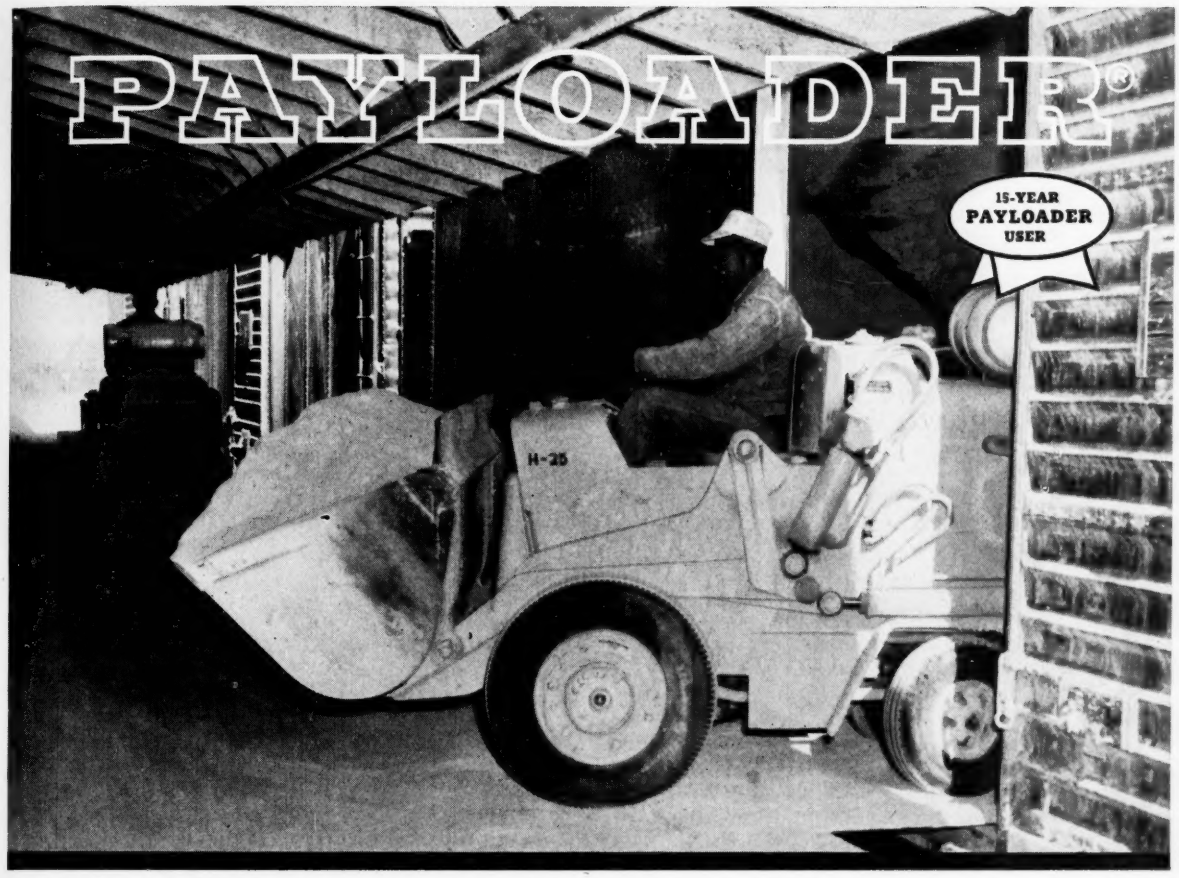
Kanigen Division

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South LaSalle Street, Chicago 3, Illinois

KANIGEN GENERAL AMERICAN TRADE MARK

Offices in principal cities



"proven dependability keeps materials moving"

"We have been using PAYLOADER *tractor-shovels since 1946 but we find that the H-25 is an all-around bigger horse," says J. T. Paul, Plant Supervisor for the Victor Fertilizer Company in Chester, South Carolina. "It has excellent digging power plus fast delivery speed—yet, it can be maneuvered in real close quarters to do the job that previously called for smaller loaders. In our operation,* PAYLOADER *equipment has given us continuous production service with outstanding dependability."*

VICTOR FERTILIZER is a typical mixing plant. They serve an area within a 100-mile radius largely devoted to cotton, general agriculture and dairy industries. Their present PAYLOADER equipment consists of a new 2,500-lb. capacity Model H-25, two smaller HA's (2,000-lb. operating capacity) and a larger Model HE for all railroad car unloading, bagging and mixing duties.

THE IMPRESSIVE REPORT they give on the H-25's performance is typical, too, because it is the most productive rubber-tired loader ever built in this size range:

Mechanically—it combines 2,500-lb. capacity, 6-ft. turning radius, full power-shift transmission, power-steering and power-transfer differential to move big tonnages even in close quarters.

Maintenance—Many special features have been "built-into" the H-25 PAYLOADER to protect it against costly downtime: A dry-type air cleaner system, cartridge type oil filters, sealed and self-adjusting hydraulic service brakes, parking brake enclosed in transmission, special grease and oil seals on all vital pivot points.

WHY NOT CONTACT your nearby Hough Distributor and have him demonstrate how the greater production, lower maintenance performance of an H-25 can reduce your cost in bulk handling? See him soon or return the coupon.

HOUGH®

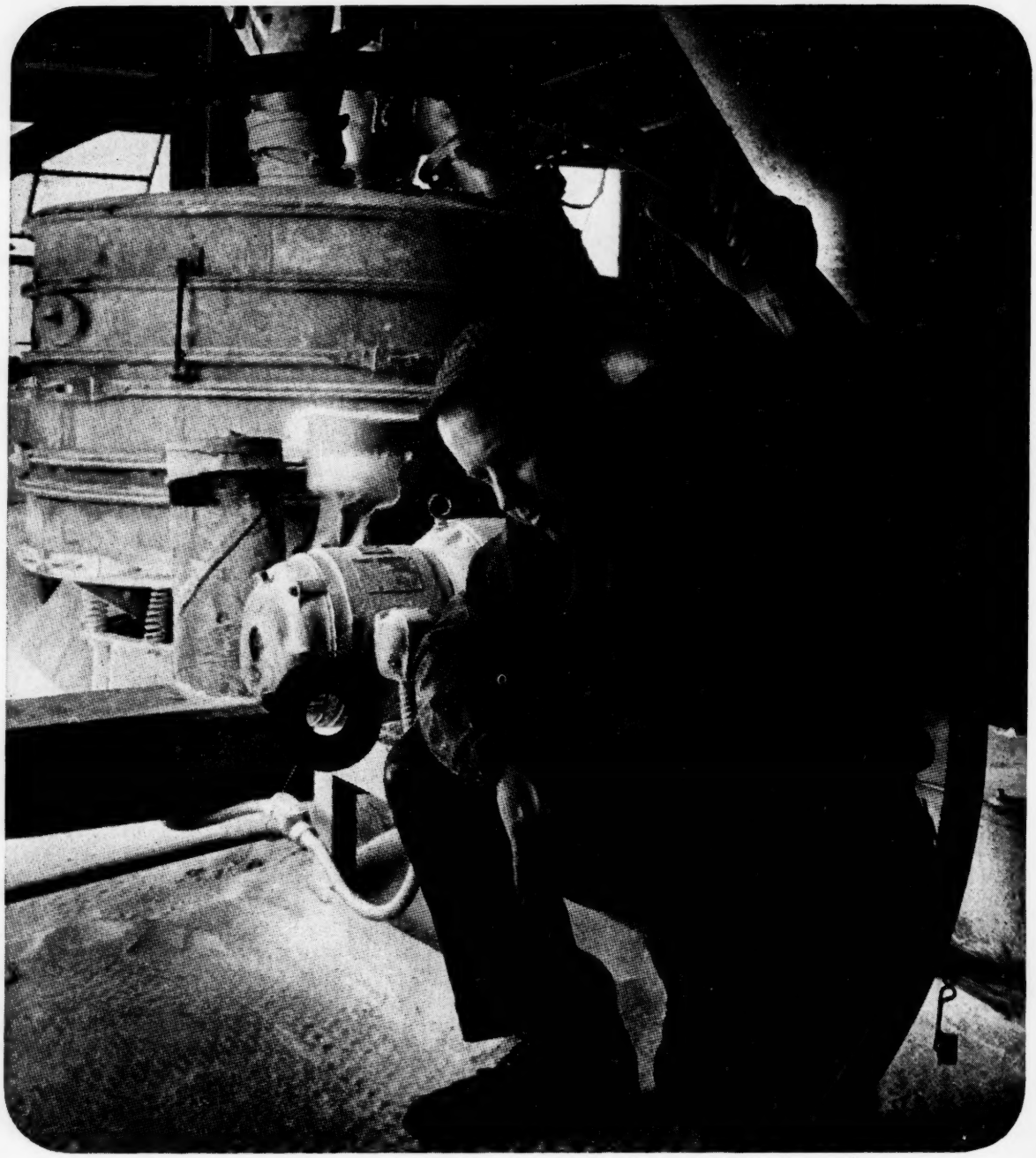
THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY - INTERNATIONAL HARVESTER COMPANY

HOUGH, PAYLOADER, PAYMOVER, PAYLOGGER, PAYDOZER and PAY are registered trademark names of The Frank G. Hough Co., Libertyville, Ill.

THE FRANK G. HOUGH CO. 10-A-1
754 Sunnyside Ave., Libertyville, Illinois

Send "Industrial Material Handling from A to Z"

Name
Title
Company
Street
City State



Only 'round the clock screening meets Maas' custom requirements

SWECO Vibro-Energy Separators operate 24 hours a day, seven days a week, at A. R. Maas Chemical Co., division of Stauffer Chemical Co., South Gate, Calif. Costly down-time and maintenance ordinarily caused by screen blinding are reduced to a minimum with SWECO's effective ball tray design. Maas installed one of the first SWECO Separators in 1953. Today, seven 48-inch, multiple-deck units handle its production of photo chemicals, organic chelating agents, and a complete line of sodium phosphates, all to exacting customer specifications. Units transmit no vibration so are easier and more economical to install, and they use only 1/3 of the normal power required. The SWECO Separator's quick screen change and longer screen life cut operating and maintenance costs. For full details, application data, or free screening demonstration in *your* plant with *your* materials, write SOUTHWESTERN ENGINEERING CO., 4800 Santa Fe Avenue Los Angeles 58, Calif., Dept. 3832.

SWECO

+Vibro-Energy separators, grinding mills, finishing mills+

"See SWECO Booth 1250-52 Chem Show, Nov. 27-Dec. 1, N.Y.C."

Anhydrous Ammonia
Brine
Caustic Catalyst
Caustic, 50% Solution
CO_2, Liquid
Diethylene Glycol
Di-propargyl Ether
Hydrocarbons

WHAT CHEMICALS ARE GIVING YOU PUMPING PROBLEMS?

Methanol Amine
Naphtha @ 300° F
Nickel Catalyst Slurry
Nitric Acid
Pulp Density Mineral Ore
Silica Gel
Slurry
Sulfuric Acid
Tanning Solution
Urea
Water

Where the pressures are high . . . or the liquids are tough to handle . . . that's for us!

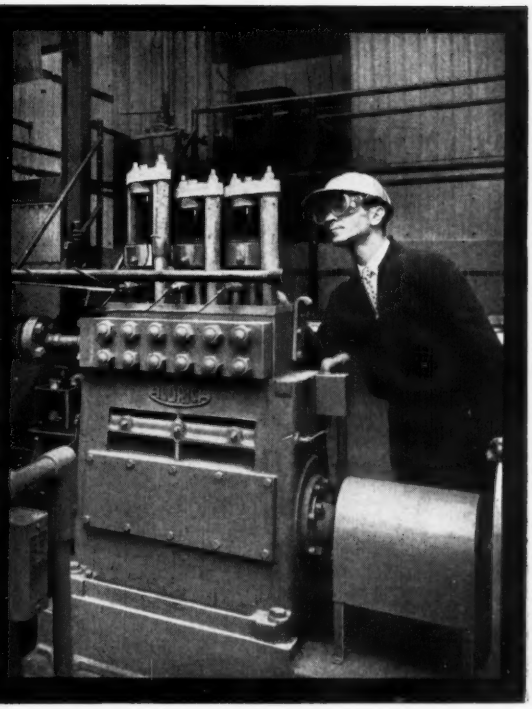
The list above is typical of the special pumping problems we have solved for the process industries . . . problems that call for an intimate knowledge of what it takes to handle corrosive, viscous, abrasive or highly compressible fluids over a wide range of pressures and temperatures.

This specialized experience is ready to work on your specific pumping problems . . . to explore them in depth and find a *better* answer, not just *an* answer.

Aldrich Pumps range from 25 to 2500 hp.; pressures to 50,000 psi. For fast reference see our insert in *Chemical Engineering Catalog*. For complete data write ALDRICH PUMP COMPANY, 3 Gordon Street, Allentown, Penna.

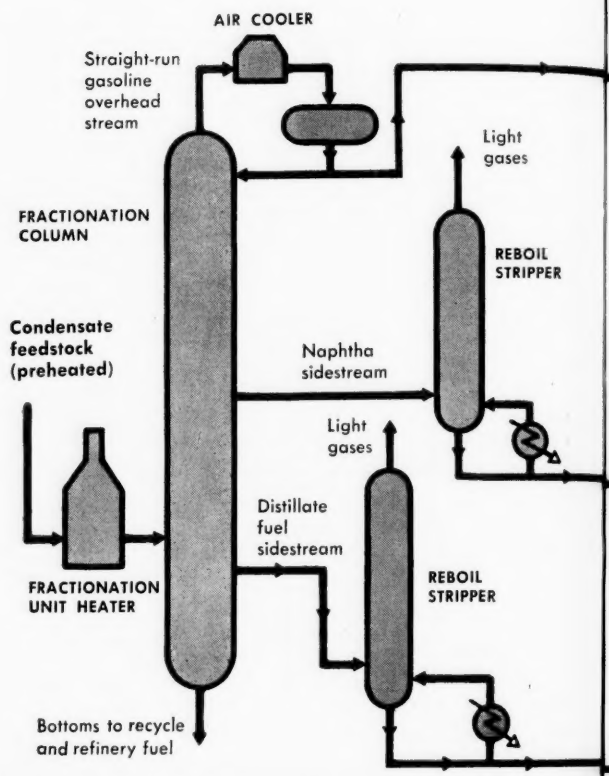
The tough pumping problems go to

ALDRICH
SUBSIDIARY OF INGERSOLL-RAND

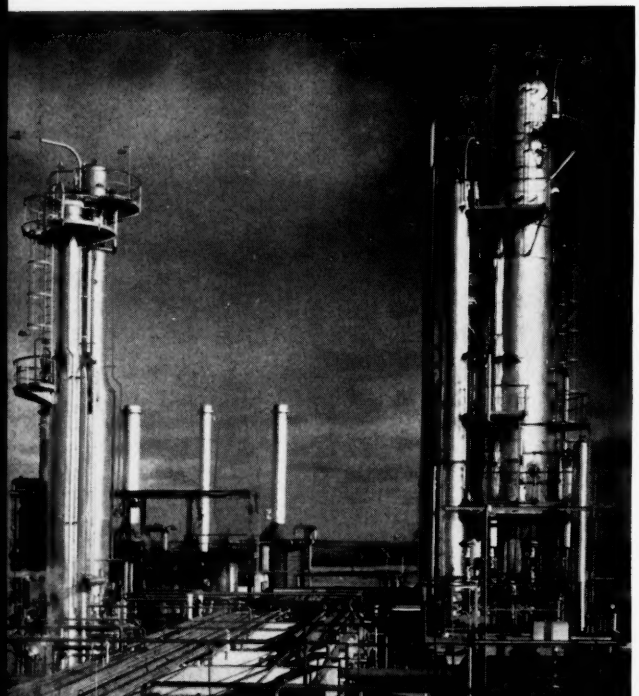


Process Flowsheet

"Oil" Refinery, New Style, Geared To Hydrocarbons Trend



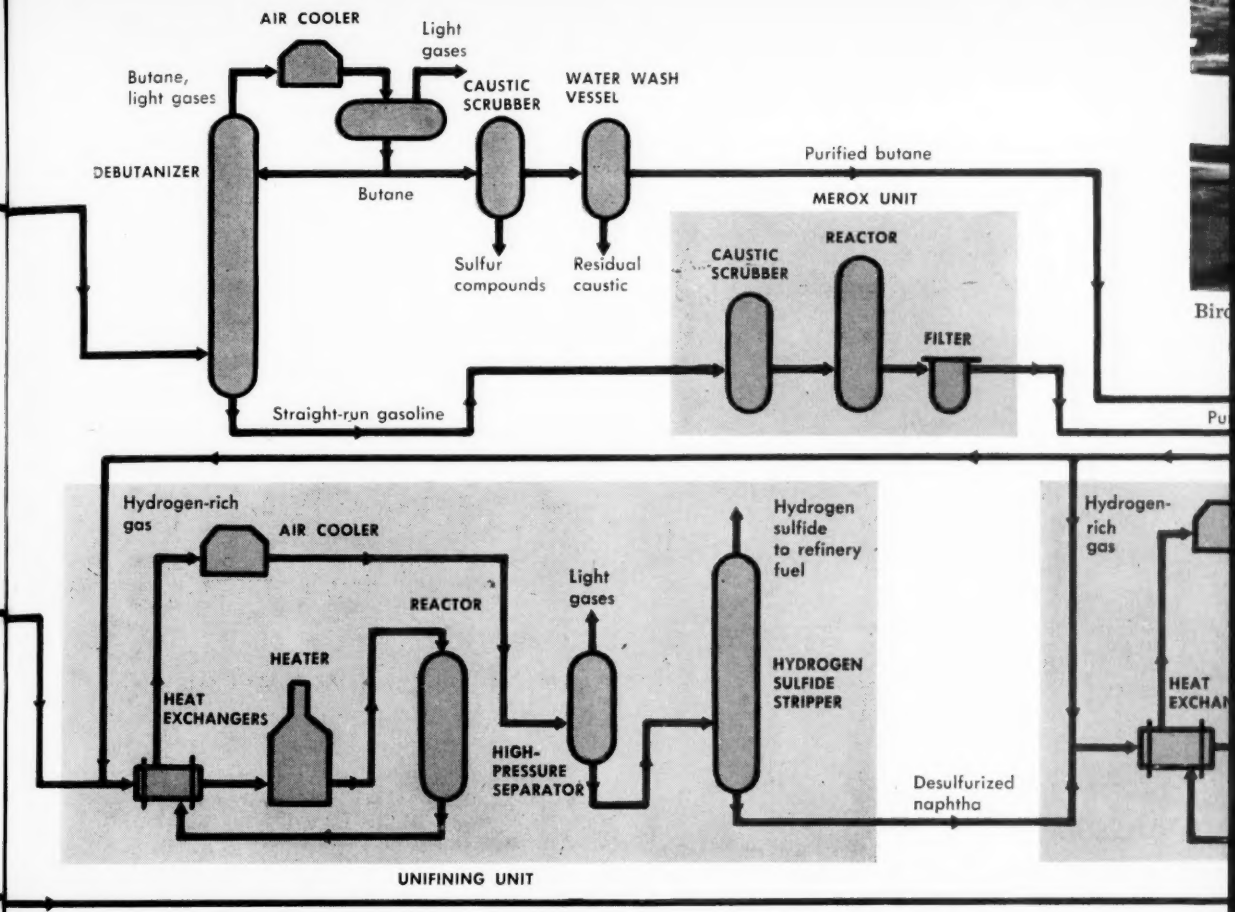
Unfold flowsheet



North view of the process area shows the crude fractionating unit on the left. The Platformer/Unifiner towers are to the right.

A novel Canadian refinery may be the pacesetter for a new look in hydrocarbons production. It yields gasoline and distillate fuels with minimum processing, while providing a logical outlet for byproduct condensate from natural gas.

N. P. CHOPEY, *Assistant Editor*



An unusual, 5,000-bbl./day refinery of Canadian Oil Cos., Ltd., near Innisfail, Alta., is dovetailing into Canada's booming natural-gas economy.

On stream since last fall, the $4-million facility produces butane, premium and regular gasolines, domestic heating oil and diesel fuel. But, it is designed primarily to process not crude oil but byproduct condensate from natural gas processing.

Condensate is a rich feedstock, with gasoline yield around 80%. Therefore, the refinery processing sequence is simple. Basically, it consists of a feed fractionator followed by three units that use processes licensed from Universal Oil Products Co.: a Merox unit to remove sulfur from straight-run gasoline, and Unifiner and Platformer units to purify and reform naphtha.

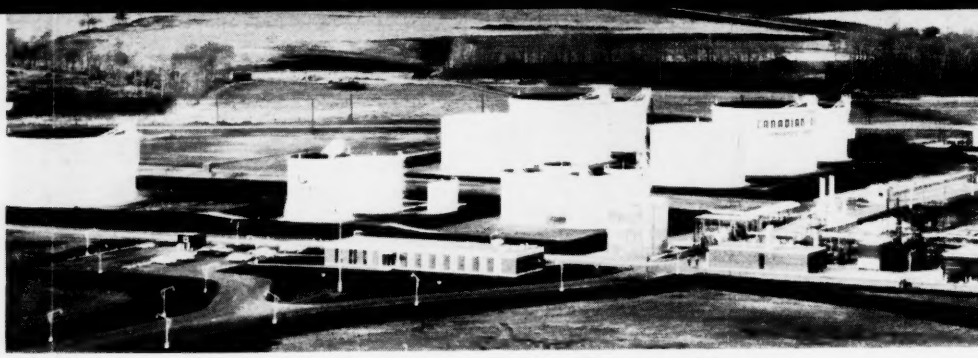
Engineered and built by Canadian Bechtel Ltd., the refinery boasts other features, too. One is feedstock flexibility—feed may be either condensate or a mixture of condensate and crude oil. And, process units are in a tightly integrated pattern, are physically located as close as practical to natural product flow. This gives several advantages:

- Process control is easily consolidated.
- Minimum process reheating is required.
- Refinery plot plan can be small.
- Investment for pumping, piping and intermediate storage is low.

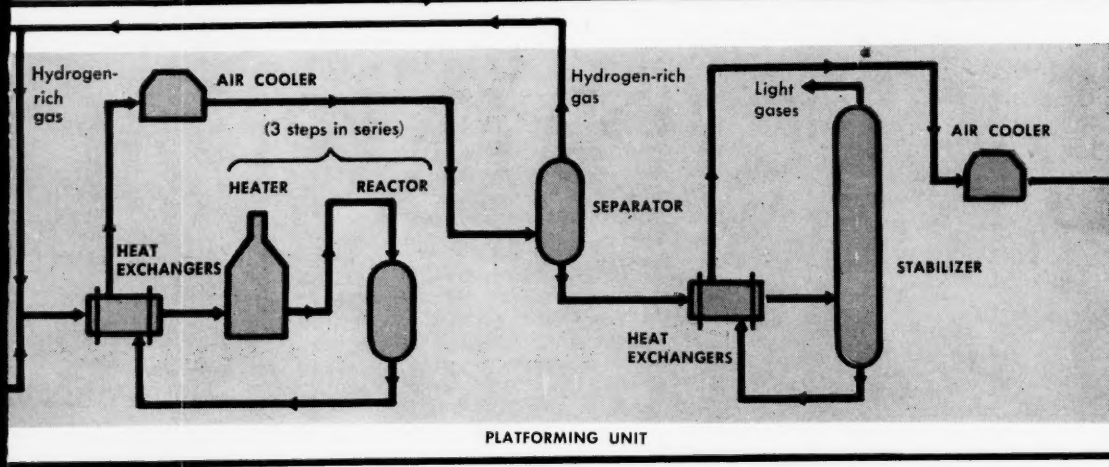
The area is noted for dry climate, so the plant uses air-fin coolers for virtually all process cooling. Water consumption is only 15 gpm.—in contrast with 30,000 gpm. at Canadian Oil's refinery in Sarnia, Ont. All pumps except one have electric drives; steam use is confined mainly to equipment tracing and heating of buildings. The facility is highly automated, and its operating force consists of one day-foreman plus shift crews of a foreman and three operators.

▶**Feedstock**—Condensate feedstock, which currently comes from a gas processing plant at Carstairs, Alta., is preheated in heat exchangers and then goes to the fractionation-unit heater. Latter raises the temperature of the feed to nearly 650 F.

Heated stream enters the fractionation column, a 66-ft. tower that yields straight-run gasoline overhead, naphtha and distillate-fuel sidestreams, and a heavy bottoms stream. A portion



Bird's eye view reveals neatness and expanse of Canadian Oil's new refinery.



lated.
required.
.
g and inter-

ate, so the
all process
15 gpm.—in
n Oil's refi-
pt one have
d mainly to
ldings. The
s operating
shift crews

which cur-
lant at Car-
angers and
eater. Lat-
d to nearly

onation col-
ght-run gas-
e-fuel side-
. A portion

of the latter is recycled; a part is used for fuel.

The distillate-fuel cut passes through a reboil stripper that takes out light ends, then goes to storage for sale as domestic fuel oil or diesel fuel.

►**Overhead**—Meanwhile, the overhead stream from fractionation is condensed and sent to a debutanizer that removes butane and other light gases. This light stream is cooled. Uncondensed gases go to refinery fuel; the butane undergoes a caustic wash that takes out sulfur, and a water wash to remove residual caustic. Purified butane is sent to storage, where it is available for gasoline blending.

Straight-run gasoline from the bottom of the debutanizer enters the Merox unit. Here, it first receives a caustic scrub, then enters the Merox reactor for mercaptan removal. At Canadian Oil's unit, this reactor contains a solid-bed arrangement of an undisclosed organometallic catalyst supported on a carbon base.

Effluent is filtered to remove residual caustic and goes to storage for gasoline blending.

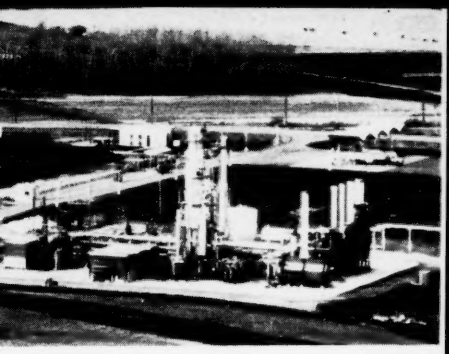
►**Naphtha**—The naphtha cut from feed fractionation is stripped in a reboiler, to remove light gases. It is then ready to
which takes out sulfur and
harmful to the Platformer ca

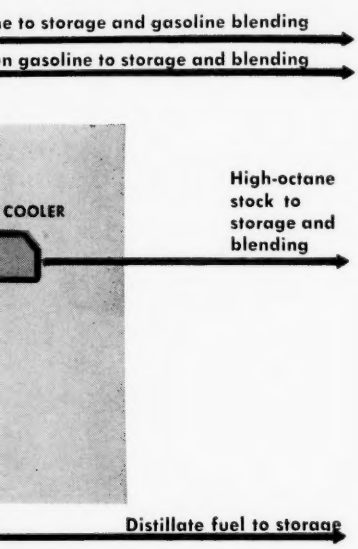
At the Unifiner, the stock
600 F. and fed to a reactor
molybdenum catalyst. In this
content converts to hydrogen

Effluent is cooled and p
then enters a separator at ab
gases leave overhead, while t
goes to a stripper tower that t
gen sulfide, which is used as

Desulfurized naphtha goes
where it is combined with hyd
ture heated to about 1,000 F.
roughly 550 psi., enters a re
platinum catalyst. This he
quence is repeated twice more
naphthenic hydrocarbons are
aromatics. Effluent is cooled
separated at about 500 psi.

After reheating, the liqu
rator enters a stabilizer that
Stabilized high-octane product
to storage for gasoline blen




e to storage and gasoline blending
n gasoline to storage and blending
COOLER
High-octane stock to storage and blending
Distillate fuel to storage

ready to enter the Unifiner, ulfur and other contaminants tformer catalyst.

r, the stock is heated to about a reactor containing a cobalt- yst. In this vessel, the sulfur o hydrogen sulfide.

oled and partially condensed, rator at about 300 psi. Light ad, while the separator liquid ower that takes out the hydro- is used as refinery fuel.

aphtha goes to the Platformer, d with hydrogen and the mix- ut 1,000 F. Heated stream, at enters a reactor containing a This heating-reacting se- twice more, during which the arbons are dehydrogenated to t is cooled, and hydrogen is 500 psi.

g, the liquid from the sepa- ilizer that removes light ends. ne product is cooled, then goes soline blending.

CHEMICAL

BEMI-STRIP* BAGS WON'T OPEN . . . UNTIL YOU GRAB THE TAB!

Manufacturers are now using millions of these rugged multiwall bags with the patented easy-opening TAB. Their products are shipped, stored, and handled in Bemi-Strip bags with complete confidence that they will not open accidentally.

Your customers, too, will appreciate getting bags that are intact, yet open easily and safely without the aid of cutting tools. Material pours cleaner since there are no thread ends to contend with . . . and in many cases, the bags can be reused because they are undamaged in opening.

Look for the TAB. It is your assurance that you are getting the original easy-opening bag with guaranteed locking features.

Call your local Bemis packaging specialist. He can demonstrate these Bemi-Strip benefits right in your own plant. Bemis Bro. Bag Co., 408-R Pine Street, St. Louis 2, Missouri.

*Trade-Mark

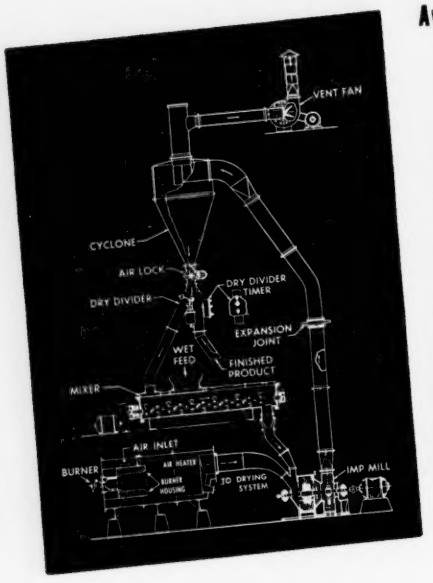
Bemis

where packaging ideas are born

FLEXIBILITY

IN APPLICATION WITH C-E RAYMOND

Flash Drying SYSTEMS



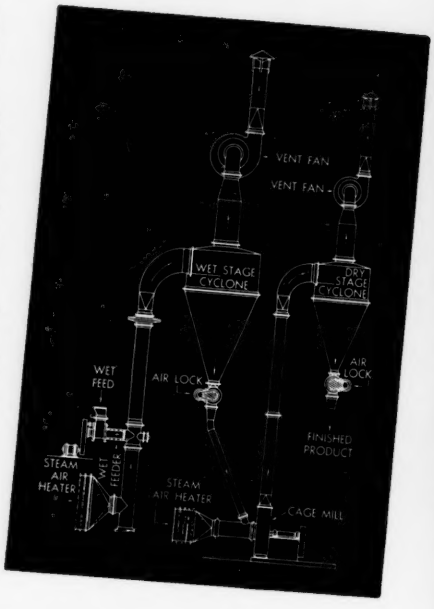
Available in following types . . .

FLASH DRYING and PULVERIZING with the IMP MILL.

FLASH DRYING and DISINTEGRATION with the CAGE MILL.

FLASH DRYING by AIRSTREAM without DISINTEGRATION.

FLASH DRYING by MULTI-STAGE SYSTEM combination of AIRSTREAM and the CAGE MILL.



IF there is any phase of your manufacture that requires the drying of materials in finely divided form, *Raymond Flash Drying* offers advantages, which will simplify the process, improve the product, reduce operating and maintenance costs.

This is a versatile system that can be readily adapted to your particular problem. The standard equipment may be furnished with different component units for such operations as:

Drying and grinding simultaneously with the removal of any specified percent of moisture.

Drying and disintegrating the natural material to normal particle size without reduction.

Drying finely divided material by airstream system to make a fluffy, free-flowing product.

Raymond equipment handles the material automatically in a clean, safe, dust-free operation. Drying is instantaneous with excellent control of the final moisture content.

Write and tell us the requirements of your finished product—we can advise you on the type of Flash Drying unit needed to handle it for any capacity rating.

FOR FURTHER DETAILS, SEND FOR RAYMOND FLASH DRYING CATALOG NUMBER 82E

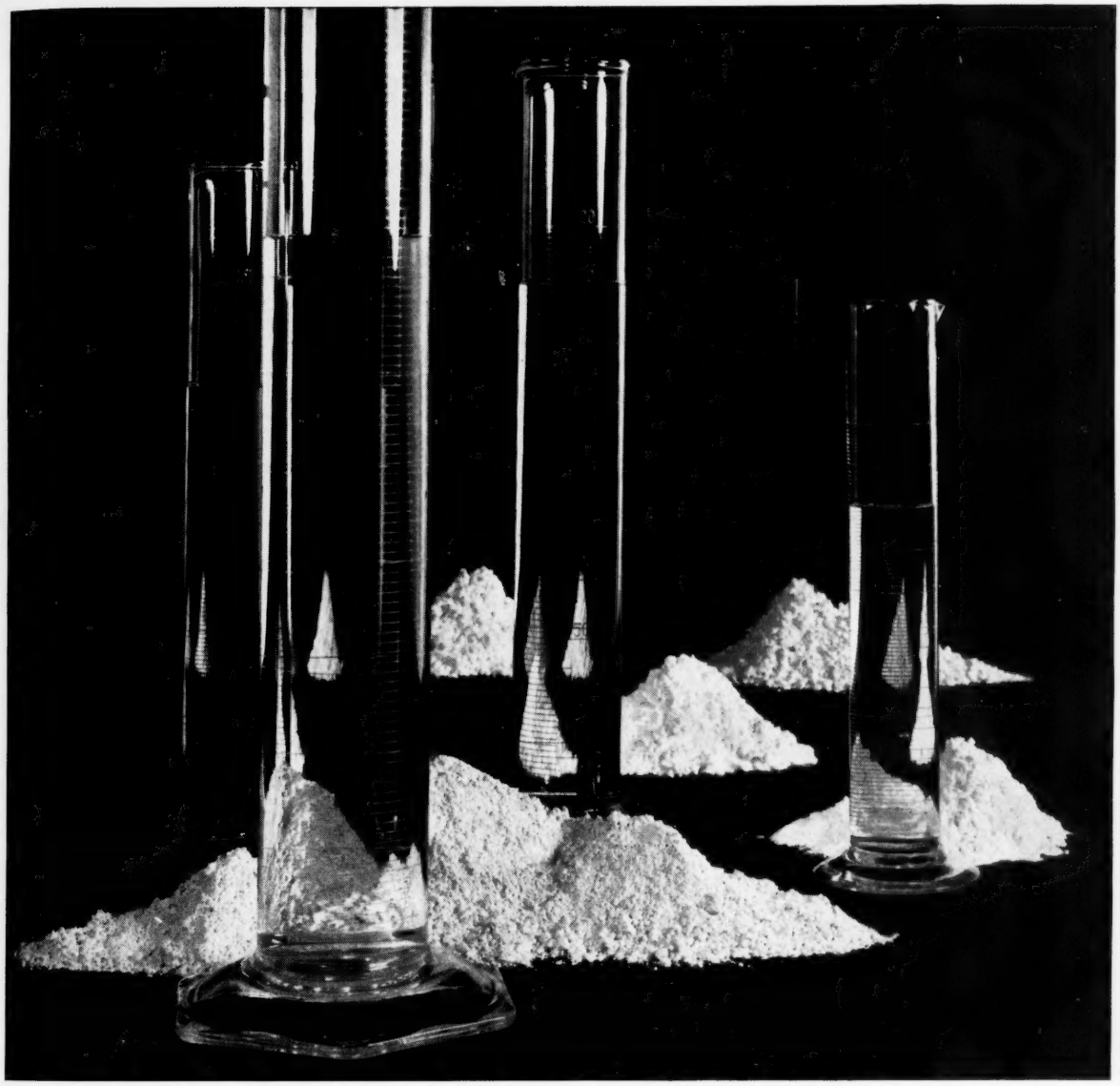
COMBUSTION ENGINEERING, INC.

Raymond Division

Combustion Engineering-Superheater Ltd.
Montreal, Quebec, Canada

427 WEST RANDOLPH STREET • CHICAGO 6, ILLINOIS

Sales Offices in all Principal Cities

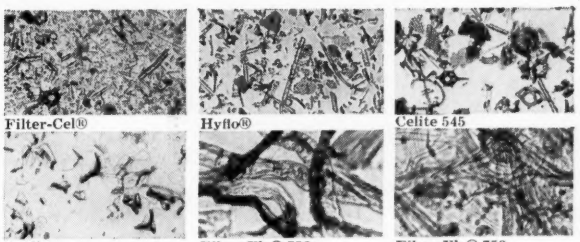


The right grade for every degree of clarity with Celite Filtration

For any filtration problem, there's a Celite® filter aid grade that gives you the exact degree of clarity desired at the fastest flow rate obtainable. Celite is available in many different grades, including special grades for specific applications. No other supplier gives you so wide a choice.

Celite's lower wet density means greater surface coverage, and its higher uniformity provides more consistent results from month to month, carload to carload, year after year.

For full details on how Celite gives the fastest, most efficient filtration at the lowest possible cost write: Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario. Cable: Johnmanvil.

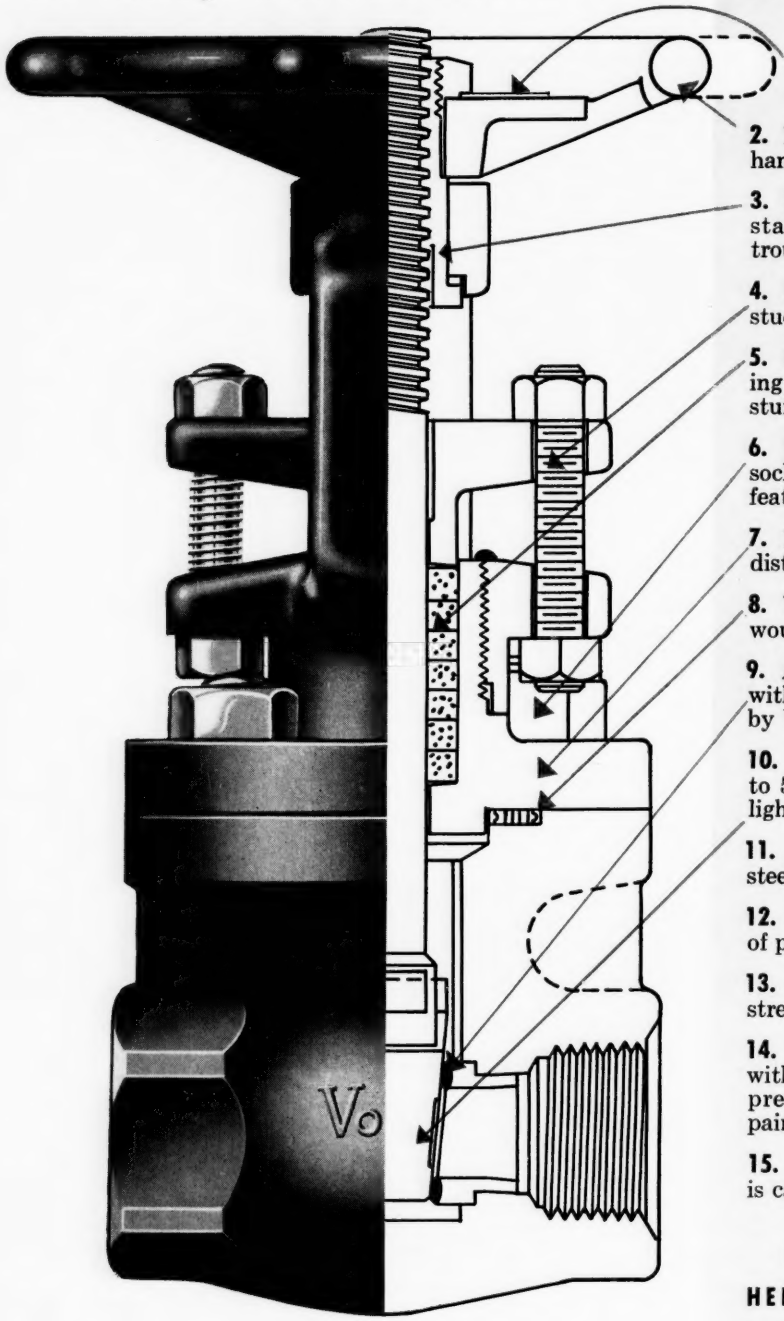


These photomicrographs show the range of characteristics available with Celite filter aids. 100μ

JOHNS-MANVILLE

JOHNS-MANVILLE PRODUCTS

The only valves with ALL these features!



1. Complete identification on metal disc.

2. Depressed-center, knobbed handwheel avoids hand injury.

3. Hi-temperature, anti-galling stainless steel yoke nut insures trouble-free service.

4. Stainless steel packing gland studs and nuts won't corrode.

5. Quality general purpose packing in the only adequately sized stuffing box in the industry.

6. Bolting nuts have clearance for socket wrenches — a real safety feature!

7. Round bonnet flanges for even distribution of bolting stresses.

8. Widest, best designed, spiral wound gasket for leak proof service.

9. All gate valve seats hard faced with Stellite — standardized only by Vogt.

10. Stainless steel gates hardened to 500 Brinell with flatness of two light bands (.000022 inches).

11. All pressure parts are forged steel to insure safety.

12. Maximum interchangeability of parts.

13. Fillets on all corners increase strength.

14. All exterior surfaces are treated with a phosphate coating for rust prevention and as a base for painting.

15. A complete line of Vogt valves is carried in stock.

For literature write to Dept.24A-FC.

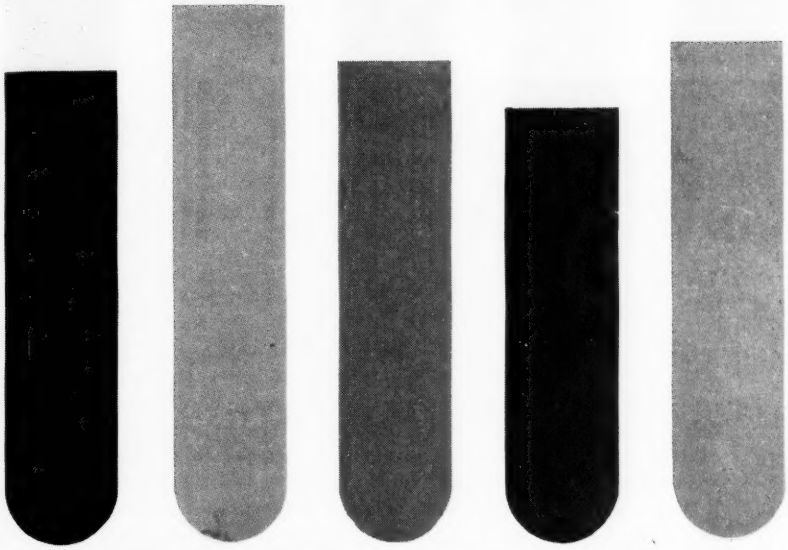
HENRY VOGT MACHINE CO.

P. O. Box 1918, Louisville 1, Kentucky

Vogt FORGED STEEL VALVES fittings, flanges & unions

SALES OFFICES: Camden, N. J., Charleston, W.Va., Chicago, Cleveland, Dallas, Los Angeles, New York, St. Louis

For Direct Long Distance to Louisville dial: 502 ME 4-9411



WHAT'S NEW IN CHEMISTRY?

Some 400 chemical engineers met in Chicago last week at a conference designed to give them a quick but comprehensive look at "New Trends in Chemistry." This conference, jointly sponsored by Armour Research Foundation and this magazine, produced 13 authoritative papers that will be published in this and subsequent issues of CHEMICAL ENGINEERING. It featured a "small-meeting atmosphere" that afforded participants leisurely opportunities to make new contacts and pick up new information.

This is our second such conference. In the first, at Kansas City a year ago, we collaborated with Midwest Research Institute. The next one, scheduled for April 1962 at San Antonio, is being arranged jointly with Southwest Research Institute. The pattern that has been established for these annual conferences is for us to invite the joint sponsorship of a nonprofit research institute, which participates in the selection of conference theme, papers and speakers, and handles local arrangements. On its part, CHEMICAL ENGINEERING works with the speakers, makes the preprints and publishes the papers.

There may be those who ask why we have chosen to augment the already overflowing schedule of technical meetings. We might answer that we are aiming at a fresh concept in technical meeting planning, one which is different from that of the technical societies and noncompetitive with them. The basic idea is to select meeting themes that are outside the normal scope of existing technical societies. The conference just past, for example, set as its goal the survey of more than a dozen fields of chemistry in such a way that chemical engineers, few of whom have any opportunity to keep up with more than one branch of chemistry, could learn quickly of recent advances in many fields, and learn in a way that recognizes the professional differences between chemist and chemical engineer.

Similarly, the conference a year ago on "The New Chemical Engineering" sought to alert chemical engineers to the increasing dependence on mathematics, physics and chemistry that is inevitably making our profession more "scientific" in character. In neither case have the technical societies approached such subjects except for the benefit of those who are already expert in these areas.

With this background, those readers who did not attend the Chicago conference can now turn the page for an up-dating in high-temperature and high-pressure chemistry. Each subsequent issue through the end of the year will carry two or three additional conference papers, dealing with such subjects as physical chemistry and catalysis, the solid state, metallic complexes and nonaqueous chemistry, organic and inorganic polymers, organic semiconductors, and radiation chemistry and ion exchange resins and membranes.

—CECIL H. CHILTON

JOHN L. MARGRAVE
University of Wisconsin

Since high-temperature chemistry has become one of the more interesting and active research fields in the last 15 *years, there have been many reports of new and unusual types of molecules generated in flames, shock tubes, electric arcs or other high-temperature systems. This paper discusses experimental and theoretical approaches to understanding such phenomena, in terms of molecular structures and thermodynamics.*

When one wants to explain what is happening in a new system, he starts from his understanding of some other system and then by analogy extends his ideas to the new uninvestigated area. To predict what should happen at high temperatures, he obviously would try to understand what happens at low temperatures and then extend his knowledge into the new region.

To organize chemical observations about low-temperature phenomena, one may formulate these simple familiar rules: (1) *valences (oxidation states) of atoms are simple and understandable in terms of electronic ground-state configurations;* (2) *atoms prefer to form molecules that have a maximum number of paired electrons; odd molecules are unusual;* (3) *filled octets are desirable electronic configurations;* (4) *most spontaneous reactions are exothermic;* (5) *condensed phases are strictly stoichiometric. Rules of this sort are satisfied by most organic molecules and are suggested as a starting point for predicting what happens in a high-temperature system.*

Further, one might think about the relationship between a condensed phase and its equilibrium gas phase. If one considers organic systems, he will surely conclude that the species in high-temperature vapors are closely related to the structural units in the corresponding liquids and solids since in many common organic and inorganic systems, the formula unit or molecular species that makes up the solid or liquid is the same as the structural unit in the vapor.

For instance, most chemists are not at all bothered by writing $H_2O_{(liquid)} \rightarrow H_2O_{(gas)}$ *although this could be interpreted to mean that* H_2O *molecules are structural units in the liquid and also in the gas. When one thinks more critically, he needn't necessarily believe that single* H_2O *molecules are present in the liquid, but perhaps there are conglomerates of* H_2O*—maybe two-, three- or four-molecule units—and perhaps the number of molecules per conglomerate may change as a function of temperature. This is not, however, indicated in the simple equation for evaporation.*

Finally, on the basis of experience with organic and simple inorganic materials, one concludes that there are surely cases where polar molecules do *associate extensively in vapors. For instance, it is well known that aluminum chloride is present in the vapor mainly as a dimer at low temperatures. But as the temperature is increased, the amount of dimer decreases. Consequently, one might generalize that as the temperature gets higher, solids, liquids and vapors become simpler.*

This kind of reasoning by analogy was probably applied by most chemists prior to 1940, *and may be why very few people were really excited about high-temperature chemistry. If one can predict high-temperature phenomena by these simple generalizations, there is then little reason to investigate them further.*

High Temperature and Plasma Chemistry

Some High-Temperature Generalizations

Oxidation States

A loophole in the general rules commonly used for low-temperature chemistry is the concept that oxidation states are almost "magic numbers," characteristic of the atoms and independent of temperature and pressure. Actually, the oxidation-state concept should involve the possibility of considerable variation especially with temperature and pressure. The "familiar" oxidation state of an element is familiar merely because we happen to live and experiment in a world at approximately 25 C. and 1 atm. pressure. On a planet where the temperature was 500 and the pressure 10^{-3} atm., "familiar" oxidation states would be very different. A familiar oxidation state may not be particularly desirable thermodynamically—but merely one that, kinetically, doesn't disappear so fast.

Consider a specific example of how the oxidation state of an element—in this case, magnesium in magnesium fluoride—can vary as a function of temperature. At low temperatures, the familiar species is MgF_2 (ionic solid) and the oxidation state of magnesium is the classical value, +2. At medium temperatures, MgF_2 vaporizes probably as MgF_2 gas, and the oxidation state is still +2. At higher temperatures, there is dissociation and MgF become the stable gas; +1 is the oxidation state. At extremely high temperatures, dissociation to the elements occurs and the zero oxidation state would be the prevalent one. In every system, one should consider the variation of oxidation state with temperature.

Concerning the influence of pressure on oxidation states, consider the interesting suggestion of Hall[1] that if atoms were compressed sufficiently, the energetic order of the arrangement of the atomic orbitals could actually be changed.

For example, in the elements potassium, calcium, scandium (atomic numbers 19, 20, 21), the order of orbital energies is such that there are "s" electrons outermost in all these atoms but there is also an inner "d" electron in scandium. Under high pressures and high temperatures, this 3-d orbital might become more energetically desirable than the "s" orbital. Then, potassium might have 3-d electrons in the outermost electrons; this configuration change would alter the oxidation state since the latter is merely evidence of how the atom exchanges or shares electrons and forms electron bonds. Thus, pressure could be a very important variable.

When subjected to high pressures, some atoms undergo abnormal changes in resistance, which suggests that the availability of conduction electrons and perhaps the order of filling of the electronic subshells may change at the high pressures.

Diatomic Molecules

The known high-temperature molecules in 1940 were summarized almost completely in the first edition of Herzberg's classical book on the spectra of diatomic molecules. In the second edition (1950) even more diatomic molecules are listed.[2] Most of these were observed in electric discharges or in high-temperature flames. This was (in 1950) the major summary of our knowledge of high-temperature species—they were mainly diatomic.

Herzberg listed about 400 diatomic molecules in his second edition, of which about 125 were gaseous halides, about 60 were gaseous oxides, but only 13 were gaseous nitrides. This seems rather unusual since nitrogen is almost as electronegative as oxygen, and yet there are so few metal nitrides. Since there should be combinations between electronegative and electropositive elements, metals and nitrogen would appear to

offer a good source for molecular combinations and one would expect that many diatomic nitrides exist that have not yet been discovered.

The total number of possible diatomic combinations is obviously many thousands—certainly, a lot of the possible diatomic molecules were not known in 1950. Research from 1950 to 1961 has added many new ones.

One might assume that, at least for the 400 molecules known in 1950, fairly complete data would be available. This, however, is far from true. Of the diatomic molecules listed by Herzberg in 1950, about half are very poorly identified.

Gaydon has extended the coverage of dissociation energies to 1953, and many of them are well known. In some cases, however, the uncertainties are of the order of ±1 electron volt (±23,000 calories/mole). If the heat of formation or the heat of dissociation of a molecule is uncertain by 23,000 calories, one really doesn't know very much about it.

The detailed electronic configurations, which one might expect to have been worked out by theoreticians for simple diatomic molecules, are also poorly understood, both experimentally and theoretically. The ground electronic state has not been definitely fixed for a very large number of the molecules known in 1961. This applies not only to exotic molecules but also to many of the well-known diatomic species such as BN, MgO, AlO, CaO, Se_2, etc.

Obviously, there are many, many missing pieces of data for diatomic molecules.

High-Temperature Vapors May Be Complex

An important point in any study of high-temperature systems is the justification of the increased complexity of some high-temperature vapors with increasing temperature. This was pointed out in its clearest form by Brewer.[3]

Consider the vaporization or sublimation of metal to form a vapor that consists of monomers and dimers. (It could just as well consist of monomers, dimers and trimers, and perhaps even tetramers.) When one sublimes a single atom from solid to vapor, he puts into the system the heat of sublimation of the monomer; if he then sublimes another atom, he again puts in the heat of sublimation to form the gaseous monomer. Thus, the energy needed is twice the heat of sublimation in order to get two gaseous M-atoms. One can also get two gaseous M-atoms through an alternate path by subliming directly to form $M_{2\,(gas)}$ by supplying the heat of sublimation of the dimer, then dissociating the $M_{2\,(gas)}$ into atoms and getting the dissociation energy of the dimer.

What, then, is the relative importance of dimers and monomers in the vapor over the metal M? There are two cases to consider: (1) where $\Delta H_{(dimer)}$ is greater than $\Delta H_{(monomer)}$; and (2) where $\Delta H_{(dimer)}$ is less than $\Delta H_{(monomer)}$. This obviously depends on whether the dissociation energy of M_2 is greater or less than the heat of sublimation to form the monomer.

In the first case, a plot of the log of the pressure of monomer vs. $1/T$ should give a straight line with slope ΔH_M. On the same graph, the dimer would yield a straight line of slope ΔH_D where ΔH_D is greater than ΔH_M. Since the slope for the dimer is greater, the M_2 species should gain in importance relative to the M species and may, if the entropies are appropriate, actually become predominant at high enough temperatures. This is a situation that exists for many refractory materials, and one can expect complex polyatomic species when carbides, nitrides, silicides and other refractory substances undergo sublimation or vaporization. The alternate possibility where $\Delta H_{(monomer)}$ is greater than $\Delta H_{(dimer)}$ gives the same sort of plot, but reversed. This is the situation for $AlCl_3$ where at low temperatures the dimer is more important than the monomer; at high temperatures, the monomer is more important than the dimer.

Ions Play Significant Roles

The spectrum of possible polyatomic species in high-temperature gases includes both positive and negative ions of the parent molecule, and all the conceivable fragments—with the endothermic, highly charged fragments being favored more and more. Thus, ions are the predominant species in plasma devices. Molecule ions are dissociated at $T >$ 15-20,000 K., and at higher temperatures one expects to find atomic ions of various charges. These species can be treated by the laws of classical thermodynamics, modified to take the inter-ionic attraction or repulsion into account. Interestingly enough, in low-density plasmas, the Debye-Huckel theory works very well and equilibrium calculations can be made.

From a synthetic viewpoint, ions are energetic reactants that may provide new ways to form desirable products. Ion-molecule reactions in mass spectroscopy yield strange species like CH_5^+, $ArCH_4^+$, ArC^+, etc. If neutral molecules can be isolated, even though they are metastable, a whole new realm of chemistry will be opened for exploration.

High-temperature Gaseous Molecules

Pressure and Vapor-Density Measurements[4]

One can learn about high-temperature vapors through the study of vaporization processes. One may measure total vapor pressures in a closed system with the manometer, e.g., as when measuring the vapor pressure of water at 100 C. Such a static system is not practical for measuring vaporization pressures of refractory substances (graphite at 2,500 C., for instance) and such pressure measurements yield no direct information about the nature of the vapor species unless special arrangements are made.

Another technique for vapor-pressure measurement that requires no assumption about the molecular weight or vapor species present is the classical boiling point experiment. Here one observes variation of the boiling point as a function of pressure. As one reduces the pressure over a liquid, it begins to boil at the tem-

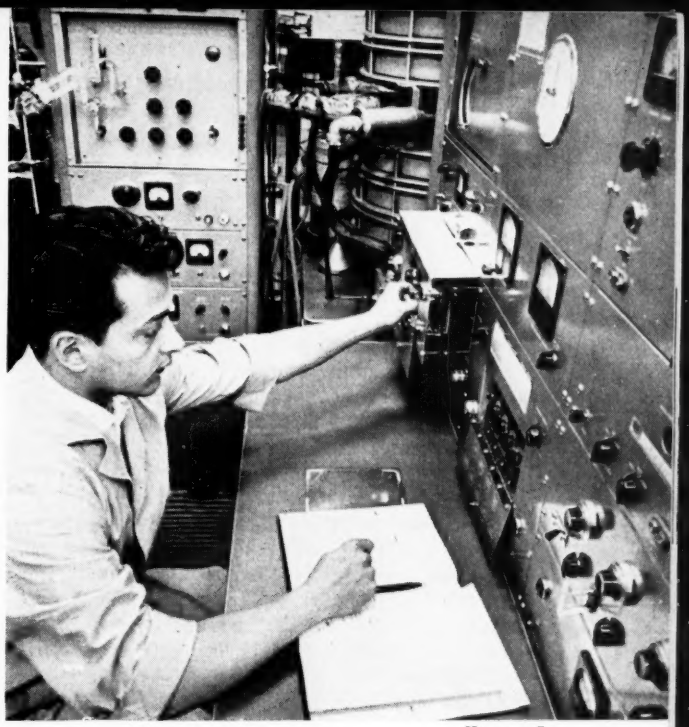
perature where the pressure in the system is equal to the vapor pressure of the liquid. This gives a unique determination of the vapor pressure without any assumptions regarding molecular weight. It has special advantages when compared with other techniques where molecular weight assumptions are required, as one may show up cases where incorrect assumptions have been made about vapor species and thus get a better idea about the true nature of the vapor.

From such experiments, one can get vapor-pressure measurements and, in combination with measurements made by other techniques, it is often found that the molecular weights of vapors are not simply those of the individual primary units in the solid.

A recent example of the application of this technique involves the alkali halides, which have been extensively studied over the past 50 years. For NaCl, NaBr, KCl, etc., it has been found that boiling point measurements do not agree with pressure measurements made by other techniques when monomeric species are assumed to be the main species present in the vapor. The only explanation for the discrepancy is that the molecular units in the vapor are not monomers. One also finds from studies of mixtures of sodium fluoride and zirconium fluoride that the boiling point calculated on the assumption that ZrF_4 is the only volatile species is not in agreement with the boiling point determined directly. Complex molecules like $NaZr_2F_9$ must be assumed in order to reconcile the measurements.

Vapor densities also give information about high-temperature gases. Around 1900, Biltz, Von Wartenburg and Nernst made measurements of vapor densities for a number of inorganic substances at temperatures up to 2,000 C. A large iridium tube was used as the heater. Essentially, a sort of Dumas experiment was performed—a substance was vaporized at the high temperature into a known volume. From the vapor-density measurements reported in 1900, it was apparent that many substances did not have the vapor densities one would predict from the simple formula unit for the solid. An interesting observation was that cuprous chloride vapor apparently had the molecular weight of a dimer, $(CuCl)_2$, so the possibility of such a complex molecular species was suggested. It was not until 1948 that Brewer and Lofgren showed that the vapor over cuprous chloride consisted of CuCl and $(CuCl)_3$ in approximately equal amounts (at the temperature of the vapor-density experiment).

Another important vapor-pressure technique is the transpiration or flow type of measurement. Here, one measures the rate of transfer of a saturated vapor by a known amount of flow gas. If one can make sure that saturation occurs and if he knows the molecular weight of the vapor species, he may then calculate the moles being transferred from the gas flow and the equilibrium pressure. A particular example of work of this type concerns the vapor species in equilibrium with water and B_2O_3. When one passes an inert flow gas over B_2O_3 at 1,000-1,200 C., the B_2O_3 vaporizes at a given rate. If a small amount of water is present in the flow gas, the rate of evaporation is enhanced about 30-50 times because of the formation of new molecular species in the vapor. One must find out what these species are and use this knowledge to make meaningful calculations from the transpiration data.



Koppers Co.

Mass spectrographs study atomic structure.

Low Pressure Techniques

Several theoretically sound approaches exist for measuring vapor pressures in the region below 1 mm.[1] Two of these are of special interest because of their wide application. The first is the Knudsen effusion technique in which one observes the rate of escape of an equilibrium vapor from a closed container through a small hole in its lid. The second is the Langmuir free-evaporation technique where one observes the rate of escape of molecules from a surface of known area into a vacuum. In both cases, the equations relating the rate of escape of molecules and the equilibrium vapor pressure involve the molecular weight of the vapor species. One normally assumes a value based on the best data available, and calculates vapor pressure.

Of special interest in the application of the Knudsen and Langmuir equations are considerations based on the geometrical configuration of the cell or surface from which evaporation takes place, and factors involved in the mechanism of evaporation that may cause the evaporation process to take place at a lower rate than that predicted from equilibrium thermodynamics. This latter situation is resolved experimentally by the introduction of a factor (alpha—the condensation or evaporation coefficient) that may have values ranging from zero to one, depending on the barrier over which evaporation processes must proceed.

Neither method can give a direct idea about the

nature of vapor species from weight loss or mass transfer measurements alone, but from this, in combination with an ingenious modification known as the torque-Knudsen measurement, one may deduce the average molecular weight of the vapor species.

High-Temperature Mass Spectrometry

One of the most significant direct methods for establishing the nature of high-temperature vapors makes use of the mass spectrometer.[5]

The pioneering work at the University of Chicago by Prof. Mark Ingraham and Dr. W. A. Chupka, and at the RCA Laboratory by Dr. R. E. Honig, has shown the versatility of this tool for high-temperature research. For example, their studies have proved what was indicated in 1900, that alkali halides consist not only of monomeric species but also of dimers and trimers; that gaseous alkali hydroxides consist of monomeric, dimeric and probably trimeric species; and that many oxides like MoO_3 vaporize as trimers, tetramers and pentamers.

When one vaporizes germanium from a Knudsen effusion cell into a mass spectrograph, and examines the mass distribution, he finds that the predominant species is Ge atoms—but a significant amount (in this case, a few percent of the vapor) consists of Ge_2, Ge_3, Ge_4, and even measurable amounts of Ge_5, Ge_6, Ge_7 and Ge_8. Germanium vapor, therefore, is far from simple and the existence of seven- and eight-atom molecules presents a very imposing problem for those who wish to explain the nature of chemical bonding in such a system. Some typical sorts of complex species that have been observed are listed in Table I.

Optical Spectroscopy

Until about 1956, most high-temperature optical spectroscopic work concerned only the visible and ultraviolet spectral regions. Very little had been done in the vacuum ultraviolet region and, though many infrared spectra of stable molecules at ordinary temperatures (and even up to 200 C.) were available, almost no one had then studied the infrared spectra of high-temperature species. Microwave spectroscopy had been extended to a few systems at temperatures of several hundred degrees.

Since 1956, there have been some definite improvements. Several investigators have tried to extend visible, ultraviolet and even vacuum ultraviolet spectroscopy to systems that are better defined by studying the absorption spectra or the emission spectra from gases that are in equilibrium in well-defined regions of a furnace. As typical studies, one might cite the observation of the C_2 and C_3 molecules by spectroscopic techniques. C_3 was observed spectroscopically only after a careful mass-spectrometric study indicated its presence in carbon vapor.

The story of C_3 is interesting. Around 1940, a band was reported in certain stellar spectra at 4,050 A., which became known as the "4,050-band".[6] Since the star was rich in carbon and hydrogen, it was thought that CH_2 might be the source of the spectrum. To learn more about the spectrum "CH_2," someone performed the crucial experiment of studying it in the laboratory in an electric discharge with some deuterium present. The spectrum remained unchanged when deuterium was substituted for ordinary hydrogen, and this eliminated the possibility that CH_2 was the emitting molecule. The spectrum remained unexplained for several years until a mass spectrometric investigation of carbon vapor showed that C_3 was a very significant species.[7] Laboratory production of the 4,050-band system, with C-13 instead of C-12 carbon, showed isotope shifts that agreed very nicely with those predicted for a linear C_3 molecule.[8] The "4,050-band" system is then due to C_3 but it required a combination of optical and mass spectrometry to prove the identity of the emitter.

The C_3 system, as well as many of the C_2 spectroscopic bands, falls in very accessible regions of the spectrum. Still, these bands have not been completely understood until quite recently. Gaseous C_2 gives rise to a number of band systems, including the well-known Swan bands, in the visible region around 5,000-5,600 A., as well as several systems in the ultraviolet and in the infrared. One important question about the C_2 band system concerns the nature of the ground electronic state of C_2: Is it a singlet or a triplet ground state? This question has now been resolved by optical spectroscopic studies which show the singlet state is very slightly ($\sim$600 cm.$^{-1}$) lower.[9]

Another optical spectroscopic study concerns the molecule Mg_2. One might predict that Mg atoms would not form a homonuclear diatomic molecule because they have two "s" electrons in a "satisfied" subshell. Further, one sees little reason why this molecule, assuming

Complex High-Temperature Species Observed With a Mass Spectrometer—Table I

Condensed Phase (In Knudsen Cell)	Vapor Species at Equilibrium (Observed as Positive Ions)
Graphite	C, C_2, C_3, C_5, and small amounts of higher polymers
Ge	Ge_1, Ge_2, Ge_3 . . . Ge_8
Al_2O_3	Al_2O, AlO, Al_2O_2, elements
Cr_2O_3	CrO, CrO_2, CrO_3, elements
WO_3	$(WO_3)_3$, $(WO_3)_4$, $(WO_3)_5$, elements
BeO	$(BeO)_1$, $(BeO)_2$ . . . $(BeO)_6$, elements
B_2O_3-H_2O	HBO_2, $(HBO_2)_3$, H_3BO_3, H_2O
LiF	$(LiF)_1$, $(LiF)_2$, $(LiF)_3$, elements
NaOH	$(NaOH)_1$, $(NaOH)_2$, $(NaOH)_3$, H_2O, elements
LiF-AlF_3	$LiAlF_4$, LiF, AlF_3, elements

it can be formed, would be very stable, or why it would be a significant gas species at 1,500 or 2,000 C. Nevertheless, if one suddenly plunges some magnesium nitride into a furnace at about 1,500 and observes the absorption spectrum of the vapor, a narrow absorption line for magnesium atoms appears after one minute. After two minutes, the line broadens and, after ten minutes, it is very broad; but one can also note three definite banded absorptions that are the spectral bands of Mg_2. From an analysis of the spectrum of Mg_2, one can establish the dissociation energy as 7 kilocalories/mole, so it is a very weak, but nevertheless an existent, molecule.[10] Actually, Mg_2 becomes a more and more important species in the saturated vapor over magnesium, at high temperatures, in spite of this very low dissociation energy, as one can see by the type of reasoning outlined in an earlier section.

Another extensively studied electronic spectrum in the visible region is the green emission observed in flames in which boron compounds are burned.[11] This is the classical qualitative test for boron. But, what is the emitter of this green color? First reported about 1823, the green color was tentatively attributed to gaseous boric acid. For reasons related to their appearance on a photographic plate, these bands were called the "fluctuation bands of boric acid." Later, it was suggested that the emitter identified with these bands was probably some boron oxide molecule, not boric acid. Finally, Singh suggested the BO molecule.

In 1954, Soulen and Margrave studied the absorption and emission spectra of the equilibrium gases over liquid B_2O_3 at about 1,500 C. They found that if one places a boat of B_2O_3 in a tube, heats it up and looks through the tube, he sees a green gas above the B_2O_3. Mass spectrographic studies of B_2O_3 effusing from a Knudsen cell have shown that the major species is $B_2O_{3(gas)}$ and since there was also a green gas over B_2O_3, it seemed reasonable to identify the green gas as characteristic of B_2O_3. The complicated spectrum is typical of that expected for a polyatomic molecule and has many lines that fall in the visible region over the range 4,000-6,000 A. Isotope shifts are easily observed by substituting B-10 or B-11 for the normal isotopic mixture, but no detailed analysis of the spectrum has yet been made.

From the rate of change of intensity of the spectrum with temperature, one finds a variation that is essentially that predicted for the rate of change of concentration of B_2O_3 molecules, i.e., the heat for the process forming the emitter at 1,500 C. $= 76 \pm 2$ Kcal./mole.

However, Kaskan and associates[12] have recently studied some boron-hydrogen-oxygen flames that also produced the green emitter. They observed that the rate of change of intensity of the green color, as one moved down the flame was similar to the rate of change of intensity of OH emission in the same flame; thus, the green emitter was disappearing at about the same rate as OH. This was unexpected since OH is a free radical, and B_2O_3 is a classically satisfied molecule; yet the green color seems to have the properties of a free-radical spectrum. Kaskan suggested that perhaps the green emitter was not B_2O_3 but some other molecule formed in the combustion process.

Further experiments have shown that this green color arises from the presence of very small amounts of oxygen dissolved in the B_2O_3. In Soulen's experiment, this was not removed.

The only way to remove the dissolved oxygen completely appears to be by purging the liquid with nitrogen or argon for some time at a high temperature so that the bubbles of purge gas carry out the dissolved O_2. From studies of the dependence of the green band intensity on oxygen pressure by Kaskan and by Greene, the emitter has been unequivocally identified as the BO_2 molecule. There is, over B_2O_3 in the presence of oxygen, a considerable amount of BO_2. When a boron-hydrogen-oxygen flame burns in air, the pressure of BO_2 is about equal to the pressure of B_2O_3 at 1,500 C. Thus, BO_2 is an important constituent of the B-O-H flame gases giving them a green color.

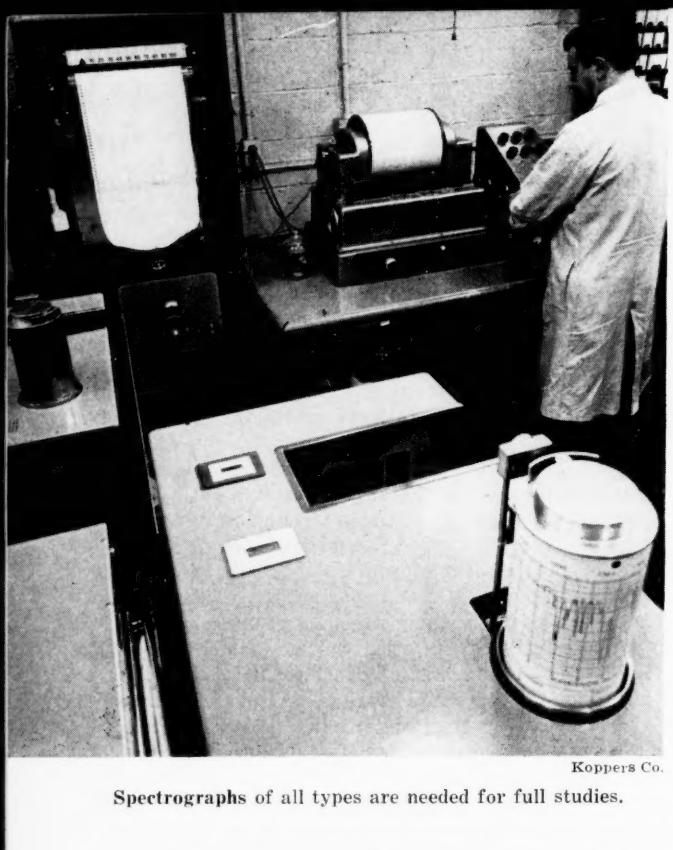
Although the green color was at first observed in 1823, the BO_2 remained unidentified, and actually unexpected, until last year. This is just another example of how optical spectroscopy involving electronic energy levels can be applied to identify or show the existence of unusual high-temperature species.

Infrared spectroscopic investigations give useful information about vibrational levels without the extra complications of electronic energy levels. Infrared spectroscopy of high-temperature systems was not extensively practiced until the work of Klemperer,[13] of Dows and Porter,[14] and of Margrave and Spinar.[15] Klemperer and associates have carried out infrared studies of various gaseous molecules at temperatures of 500-1,000 C., and other workers have extended the range to over 2,000 C. In all cases, a problem that must be resolved is the high intensity of infrared radiation from the furnace walls themselves, which can interfere with and completely mask any absorption or emission by the small concentration of gaseous molecules.

To overcome this, a very simple technique has been applied. Radiation from conventional hot-rod sources is modulated by a mechanical chopper so that the chopped infrared signal (10 cps.) is passed through the tube containing the sample. Molecules in the vapor absorb some of the chopped radiation. Also, the walls of the tube emit infrared radiation at all frequencies, and this continuous infrared radiation plus the chopped radiation arrive at the detector where a synchronized circuit looks only at the chopped portion, i.e., an a.c. ripple on top of the high-intensity background of continuous infrared. This then allows determination of the absorption characteristic of the gas.

Several possible problems are expected. At elevated temperatures, there should be an appreciable distribution of molecules over the various vibrational levels, and one would expect rather broad absorptions, perhaps similar to the spectra often obtained for aqueous solutions. This is not completely the case and one can establish with little uncertainty many of the fundamental vibrational frequencies characteristic of high-temperature molecules.

Table II lists some available studies on inorganic



Koppers Co.

Spectrographs of all types are needed for full studies.

vapors by infrared spectroscopy. The main factors that limit studies of this sort are: the amount of gas that one can get into the vapor at a reasonable temperature, and the range of energy that can be scanned. Many of the important bending frequencies in polyatomic systems lie in the region below 400 wave numbers of energy, just beyond the limits of conventional infrared spectrometers.

Structures of High-Temperature Molecules

There are many special techniques for determining molecular structure available to the high-temperature chemist.

Typical Molecules Studied by High-Temperature Infrared Spectroscopy—Table II

$AlCl_3$, Al_2Cl_6[a]	B_2O_2, B_2O_3, BO_2[b,c]
ZnX_2[a]	HBO_2, $(HBO_2)_3$, H_3BO_3[b,c]
MgX_2[a,c]	B_2S_2, B_2S_3, BS_2[b,c]
Alkali Halides[a]	HBS_2, $(HBS_2)_2$, $(HBS_2)_3$[c]
Alkali Hydroxides[a,c]	H_2SO_4, H_3PO_4[c]
Alkali Cyanides[a]	$LiAlF_4$, $NaAlF_4$[c]

(a) W. Klemperer and associates, Harvard University (b) D. White and associates, Ohio State University (c) J. Margrave and associates, University of Wisconsin

Mass Spectrometer Appearance Potentials

Mass spectrometery is not merly the art of knocking molecules apart to form ions. One can look at the pattern of fragments produced and notice how this pattern varies with electron bombardment energies. Also, one can learn about the energetics of the fragmentation processes by measuring appearance potentials for the various fragments.

Many of the fragments from mass spectrographic ionization processes are positive ions, and most instruments are arranged with the magnetic field and the accelerating electron potential for handling positive ions only. However, large numbers of negative ions are also formed, and it is interesting to know how they are produced, how stable they are, and what are their structural units. The relationships between molecular structure, thermodynamics, and the kinetics of electron-molecule and ion-molecule reactions, in typical mass-spectrometer systems, are being considered by Wahrhaftig and associates, and by Chupka.[16]

The techniques used for appearance potential measurements are simple in principle. All that one does is to vary the energy (voltage) of the ionizing electron beam that is fragmenting the molecules, and observe the ion current characteristic of a particular fragment as a function of the bombarding electron voltage. As the electron energy is decreased, the current decreases and one approaches an electron energy for which the ion current is zero. This is the electron energy, which is just enough to form the ion if one assumes there are no abnormal kinetic, vibrational or rotational energy distributions in the fragments. A plot of ion intensity versus electron voltage may go to zero sharply, but often there is an almost asymptotic approach to zero, which is more difficult to interpret.

In part, this tailing off arises from the Maxwellian distribution of the bombarding electrons from the hot filament, or it may mean that there are two processes involved that extrapolate two different appearance potentials.[17] Fox and others have pioneered in the development of mono-energetic electron guns that are useful for highly precise appearance potential measurements.[18]

From studies of the appearance potentials, one can establish bond energies and ionization potentials of the fragment ions. These are very important since electronic spectra of polyatomic species are extremely difficult to analyze.

Structures From Optical Spectroscopy

Optical spectra can yield dissociation energies, bond distances, bond angles and structures of high-temperature molecules as has already been shown for many organic molecules at lower temperatures.

The approach is not simple, however, and it requires high resolution instruments, intense light sources and the work of experienced personnel to determine the complete structure of a polyatomic molecule. In many cases, only the combination of visible, ultraviolet, infrared, Raman and microwave studies can establish the molecular configuration and energy states with high

reliability. More experimental work in optical spectroscopy is badly needed, especially including absorption spectra to establish ground electronic states.

Structures From Electron Diffraction Studies

An extremely important technique for studying gases at high temperatures is that of electron diffraction. This is presently a neglected area of high-temperature chemistry. There is only one active high-temperature electron diffraction apparatus in the United States, at Cornell University, under the supervision of Professor S. H. Bauer.[19] Russian investigators have been doing high-temperature electron diffraction work for a number of years and practically all of our knowledge of molecular structures at high temperatures by electron diffraction has come from Russian research. Akishin and his associates[20] have studied various alkaline earth halides, nickel, cobalt and iron di-halides, Li_2O, B_2O_3, B_2S_3, and other molecules, thereby resolving a number of important structural questions. For example, they find that tri-atomic molecules like MgX_2, FeX_2 and CrX_2 are linear while Li_2O is apparently bent. B_2O_3 and B_2S_3 are found to be V-shaped molecules.

Implications of Thermodynamic Properties

One can also apply thermodynamics to high-temperature systems and learn something about molecular structures. In the water-B_2O_3 system, it has been shown that by combining mass spectroscopy, infrared spectroscopy, transpiration vapor-pressure measurements (and about seven years of time) that the important species in the gas over B_2O_3-water include HBO_2, $(HBO_2)_3$, and H_3BO_3; their thermodynamic properties are well established.[21]

Consider the H_3BO_3 molecule. Structurally, this molecule is planar and involves three OH groups around boron—like BCl_3 or BF_3. These three OH groups, however, are really not completely free to rotate and one must consider that they come closer to each other in certain orientations, so that, as they rotate, there is going to be steric interference. One must treat this molecule as a system with three hindered rotations built into it. If this hindrance of rotation is significant, the thermodynamic properties will be quite different than if the rotation is completely free. From studies of the equilibrium between solid and gaseous H_3BO_3 and the thermodynamic properties of the solid, one can determine the absolute entropy of gaseous H_3BO_3. This entropy can also be calculated from statistical mechanics, assuming free rotation. The equilibrium data indicate the real entropy, and the discrepancy gives a measure of the rotational hindrance built into the molecule. Thus, one can use both equilibrium thermodynamics and reason in an indirect way to deduce something about molecular structures.

This introduction has covered some general ideas about high-temperature chemical reactions, ways of characterizing high-temperature vapors, and ways of determining the structures of high-temperature molecules, so we may now consider some of the special problems that a rise in connection with chemical bonding in high-temperature systems.

Bonding in High-Temperature Systems

Diatomic Fluorides

What is the nature of the bonding in the four molecules LiF, BeF, BF and CF? Traditionally, this bond is regarded as a relatively simple electron-pair bond, with electronegativity effects added to allow for the fact that the fluorine is combined on one hand with an atom that has an electronegativity of around 2½ and on the other with an atom that has an electronegativity of about 1 on the Pauling scale. It appears that electronegativity alone is not sufficient to account for the observed differences in bond energies from predictions, and that actually there is a great amount of π-bonding (partial double bonding) as Pauling has suggested. π-bonding in boron and aluminum halides has also been discussed for the BX_3 and AlX_3 molecules by Cotton and Leto[22] and is of considerable significance.

Available tables of data list the dissociation energy of CF as 114 Kcal./mole. For comparison, the dissociation energy of HF is 134 Kcal./mole and the electronegativity of C and H are about equal. It is hard to visualize multiple bonding between the hydrogen and fluorine in HF. In the case of CF, however, π-bonding is highly expected. The spectroscopic data actually allow two choices for the dissociation energies—either 114 or 145 Kcal./mole, and one must be cautious in choosing on the basis of spectroscopic data alone. Recent evidence suggests that the higher bonding energy, 145 Kcal./mole, is probably correct. Also, the spectra of BF indicate a dissociation energy of the order of 196 Kcal./mole and for BeF, dissociation requires 93 ± 30 Kcal./mole.[23] This seems to make the 145 Kcal./mole for CF look quite reasonable. Further, appearance potential studies made on various gaseous fluorocarbons suggest that CF_2^+ and CF^+ ions are more stable than predicted from thermodynamic data, which do not allow for extensive π-bonding in the fragments.[24]

In a recent lecture, Mulliken has reported quantum mechanical calculations on LiF that support the idea of extensive π-bonding (covalent bonding) in LiF in order to account for the internuclear distance and the bond energy. This is just another example indicating that there is extensive multiple bonding in fluorine compounds, where all the extra electrons on the fluorine may feed back into molecular orbitals to provide extra bonding and increase bond energies greatly.

Gaseous Hydroxides, Oxides and Oxyhalides[11b, 21]

The high-temperature chemist is challenged to explain structures and bonding in molecules like $(HBO_2)_3$, B_2O_3, or any one of the polymers $(MoO_3)_{3, 4 \text{ or } 5}$.

The compound $(HBO_2)_3$ is fairly straightforward

since chemists quickly think of hexagonal rings as potential structures. If one assumes a hexagonal ring of alternating B and O atoms, he can place three O-H's on the three borons and have $(HBO_2)_3$. To generalize, by substituting X for O-H, one would expect to find a whole series of (BOX)-trimer species; in fact, evidence for many of these has recently been recorded. In the hydrolysis of BF_3 in water, a solid that has the composition $(BOF)_3$ is reported. Gaseous $(BOF)_3$ and $(BOCl)_3$, as well as other related molecules, are now known.

B_2O_3 should probably be structurally analogous to B_2S_3. We may postulate a number of equally plausible structures for these molecules on the basis of classical valence and electron-pair bonding. One possibility is a bipyramidal structure with three oxygens (or sulfurs) in a plane and a boron above and a boron below; another is the formula OBOBO or SBSBS, in a *V*-arrangement; still others are a planar *W* or a distorted *W*. From electron diffraction studies, Akishin, et al., report that the *V* structure is correct. From thermodynamic measurements and isotope shifts in the infrared, one cannot eliminate the twisted *W*, although it is always hard to deduce the structure of a molecule from infrared spectroscopic studies alone. Differences between the *V* and *W* shapes would be rather subtle to detect since the only difference is whether the end oxygen points up or down; the symmetries and interatomic distances are otherwise quite similar.

As a structure for MoO_3 trimer, one can resort again to hexagonal rings and draw an alternating Mo-O structure. With molybdenum having the classical valence of six, one can place two oxygens double-bonded to each molybdenum, and this fulfills the six-bond requirement and offers a tentative structure for MoO_3 trimers. MoO_3 tetramers or pentamers may form a bigger ring that might be puckered, but there are not enough data available on such molecules to allow a real test of the structure, nor can one make any better predictions using available molecular orbital theory.

In Summary

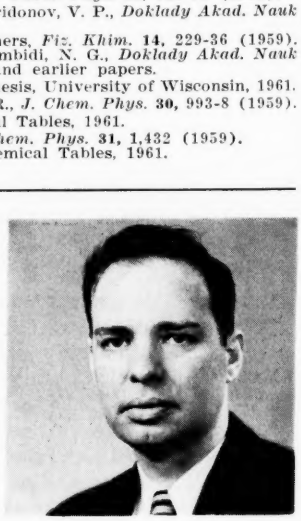
On reviewing the available data on high-temperature systems, one concludes that there is evidence for a great variety of unusual and reactive molecular species. There are, however, no simple, straightforward techniques yet developed for determining structures of molecular species that can be obtained only at low pressures under high-temperature conditions. Therefore, there is a great deficiency of information about structures of high-temperature molecules.

With this lack of information about structure, one can only assume that the ideas of bonding and molecular orbital theory that are applicable to low-temperature systems can be extended to the high-temperature regions. Many interesting opportunities are available for the testing of chemical theories to explain the structures and reactions of molecules containing 10, 15 and even 20 or more atoms that are found only in systems at temperatures over 1,000 C.

References

1. Hall, H. T., *J. Wash. Acad. Sci.* **47**, 300-4 (1957).
2. Herzberg, G., "Molecular Spectra and Molecular Structure. I. Spectra of Diatomic Molecules," Van Nostrand, New York, 1950.
3. Brewer, L., *Experientia*, Suppl. No. 7, 227-38 (1957); also, Brewer, L., Pitzer, K. S., "Thermodynamics," McGraw-Hill, New York, 1961.
4. Margrave, J. L., Chapter 10, "Vapor Pressure," in "Physico-Chemical Measurements at High Temperatures," Butterworths, London, 1959.
5. Inghram, M., Drowart, J., "Mass Spectrometry Applied to High Temperature Chemistry," pp. 219-40 in the "Proceedings of an International Symposium on High Temperature Technology," McGraw-Hill, New York, 1960.
6. (a) Herzberg, G., *Astrophys. J.* **96**, 314 (1942).
   (b) Swings, P., *Mon. Not. Roy. Astron. Soc.* **103**, 92 (1943).
7. Drowart, J., others, *J. Chem. Phys.* **31**, 1,131 (1959).
8. (a) Clusius, K., Douglas, A. E., *Can. J. Phys.* **32**, 319-25 (1954).
   (b) Kiese, N. H., Broida, H. P., *Can. J. Phys.* **34**, 1,471-9 (1956).
9. (a) Ballik, E., Ramsay, D., *J. Chem. Phys.* **31**, 1,128 (1959).
   (b) Clementi. E., Pitzer, K., *J. Chem. Phys.* **32**, 656 (1960).
10. Soulen, J. R., others, *J. Phys. Chem.* **59**, 132-6 (1955).
11. (a) Soulen, J. R., Ph.D. Thesis, University of Wisconsin, 1955.
    (b) Lerol, J. E., B.S. Thesis, University of Wisconsin, 1956.
    (c) Greene, F. T., Ph.D. Thesis, University of Wisconsin, 1961.
12. Kaskan, W., Millikan, R. C., *J. Chem. Phys.*, **32**, 1,273 (1960).
13. (a) Klemperer, W., *J. Chem. Phys.* **23**, 2,452 (1955).
    (b) Klemperer, W., *J. Chem. Phys.* **24**, 353-55 (1956).
    (c) Klemperer, W., Lindeman, L., *J. Chem. Phys.* **25**, 297 (1956) and more recent papers.
14. Dows, D., Porter, R. F., *J. Am. Chem. Soc.* **78**, 5,165 (1956).
15. Spinar, L., Margrave, J. L., *Spectrochim. Acta* **12**, 244 (1958).
16. (a) Krauss, M., others, *Ann. Rev. Nucl. Science* **5**, 241-68 (1955).
    (b) Chupka, W. A., *J. Chem. Phys.* **30**, 191 (1959).
17. Honig, R. E., *J. Chem. Phys.* **16**, 105 (1948).
18. (a) Fox, R. E., others, *Phys. Rev.* **84**, 859 (1951); *Rev. Sci. Instr.* **26**, 1,101 (1955); and later papers.
    (b) Hutchison, D. A., *J. Chem. Phys.* **24**, 628 (1956).
    (c) Frost, D. C., McDowell, C. A., *Can. J. Chem.* **38**, 407 (1960).
19. Bauer, S. H., others, *J. Chem. Phys.* **33**, 685-91 (1960).
20. (a) Akishin, P. A., Spiridonov, V. P., *Doklady Akad. Nauk S.S.S.R.* **131**, 557-60 (1960).
    (b) Akishin, P. A., others, *Fiz. Khim.* **14**, 229-36 (1959).
    (c) Akishin, P. A., Rambidi, N. G., *Doklady Akad. Nauk S.S.S.R.* **118**, 973-6 (1958), and earlier papers.
21. Randall, S. P., Ph.D. Thesis, University of Wisconsin, 1961.
22. Cotton, F. A., Leto, J. R., *J. Chem. Phys.* **30**, 993-8 (1959).
23. JANAF Thermochemical Tables, 1961.
24. (a) Margrave, J., *J. Chem. Phys.* **31**, 1,432 (1959).
    (b) JANAF Thermochemical Tables, 1961.

Meet the Author



JOHN L. MARGRAVE *is professor of chemistry at the University of Wisconsin where he has been engaged in teaching and research since 1952. His special interests are high-temperature chemistry and thermodynamics.*

He received his B.S. and Ph.D. degrees from the University of Kansas and has studied at the University of California (Berkeley) as a postdoctoral fellow. He and his associates have published over 80 papers on their investigations.

High Pressure Chemistry

ROBERT H. WENTORF, JR., *General Electric Co.*

High-pressure chemistry may be a new science, but it is probably an old art. Certainly the people of the stone age made use of the sparks that were produced by striking two stones together. And the many stone tools that they left behind testify to their understanding of high-pressure processes in the shaping of stone. It is likely that they utilized local pressures as high as 20 kilobars, about 20,000 atmospheres, in their operations. Pressures higher than these were not employed on a commercial scale until only a few years ago.

In the intervening period of many thousands of years, men have gradually increased their knowledge of high-pressure phenomena, and it is my pleasure to outline some of the major developments in an attempt to give a broad view of this field. In order to concentrate on the most recent developments, the pressure range under discussion will be restricted mostly to pressures exceeding about 20 kilobars.

In spite of the relatively high pressures initially employed in the art, the later scientific study of high pressures began at lower levels. Some of the significant early steps were made by Amagat. In the period 1869-1893, he studied compressibilities and phase relations up to 3 kilobars.

The next investigator who devoted himself to high-pressure phenomena was Professor P. W. Bridgman[1] of Harvard. From 1909 until 1955, he worked steadily at increasing the range of pressures available for research and improving the precision of measurement at these high levels. He developed many different forms of apparatus for this work and studied many phenomena, particularly those of compressibility and changes of phase. He was awarded the Nobel Prize in physics in 1946.

In 1955, General Electric Co. announced a practical method for preparing diamond from graphite by the use of high-pressure, high-temperature techniques.[2] Apparently this announcement stimulated much research in the field of high pressure so that today more than twenty laboratories all over the world are devoting significant attention to high-pressure research. Under study are a wide variety of phenomena, including electronic and magnetic transitions in metals, insulators, and semiconductors; optical and X-ray studies of materials under pressure; phase relations among minerals; kinetic studies, particularly in alloys; and the preparation of new crystalline phases.

Probably the highest static pressures achieved so far are well over 400 kilobars. Prof. H. G. Drickamer at the University of Illinois has studied the electrical behavior of metals under these pressures.[3]

The judicious use of high explosives permits us to reach pressures of several thousand kilobars by means of shock-wave techniques.[4] Although the pressures generally last but a few milliseconds at most, this method is a powerful tool for the study of matter.

Energy Requirements for High Pressure

Although the mechanical problems involved in creating static pressures of a few hundred kilobars are formidable, much higher pressures are common in nature. Table I lists the pressures associated with various processes and may help to fix a relative scale.

Table II gives the energies associated with the compressions of various substances. For most static pressures available, the energy added by compression does not approach the energy of chemical bonds. Extremely

Various pressures in the world—Table I

	Pressure Atm.
Pneumatic tire	2
City water system	5
Gas cylinder	100
Ocean deeps, chemical works	1,000
Metal forming, steel wheel on rail	3,000
Mohorovicic discontinuity, new minerals	15,000
High-pressure laboratory, diamond synthesis	50,000 to 300,000
Detonation waves, center of earth	3,000,000
White dwarf stars, degenerate matter	10^{13}

Energy added by compression—Table II

Pressure Atm.	Substance	Energy Cal./G.-Mole
1,000	Gas	3,000
1,000	Solid	1
10,000	Solid	5
100,000	Iron	20
100,000	Water	1,000
100,000	Potassium	1,600
1	Chemical reaction	20,000

high pressures, over several million bars, would be necessary to add this much energy. The physical-chemical result of such compression would be an extreme broadening and overlapping of the outer electronic states associated with chemical bonding, so that the compressed material, whatever its origin, would come to resemble a semiconductor or a metal.

In spite of the relatively low energies added by compressing a substance to 100 kilobars, such pressures may produce many interesting and useful effects, particularly if equilibria associated with volume changes are involved. For example, if a reaction proceeds with a net change of 1 ml./mole, then a pressure of 40 kilobars will alter the free energy change for this reaction by 1 kilocalorie. This is a significant amount of energy compared with chemical-bonding energies, and the possibilities of shifting chemical and physical equilibria lend much promise to high-pressure work.

Recovery of Products

In much high-pressure work, it is desirable not only to produce certain products at high pressures but also to recover them for examination or use at room pressures. This requirement imposes some limits upon the materials to be studied.

For example, bismuth metal passes in succession through at least three phase changes, each associated with a change in crystalline structure, upon compression to 100 kilobars.[5] But as soon as the pressure is removed, the bismuth changes back into its usual low-pressure form. The bismuth lattice is simply too weak to preserve the high pressure configurations against the forces of thermal agitation and atomic repulsion.

In general, one is most likely to preserve high-pressure phases by working with mechanically strong or hard materials and by keeping the temperature low during decompression so as to minimize the thermal disruption of the lattice. The best way to preserve high-pressure chemical equilibria is of course to reduce the temperature or remove the catalyst before reducing the pressure.

How to Apply Heat

High-pressure reaction chambers are usually heated electrically because such heating is simple to arrange and easy to control. For moderate temperatures up to about 600 C., the entire apparatus may be heated despite the weakening effects of higher temperatures upon it. For the highest temperatures, it is best to build a little insulated oven inside the chamber and accept the reduction in working volume and pressure transmission produced by the insulation.

Piston and Cylinder Apparatus

Moderate pressures have been produced for decades by simply driving a piston into a cylinder. When higher pressures are desired, this simple method must be modified in order to counteract the tendencies of the piston to crumble, or of the cylinder to swell or burst. If the materials of construction are too weak or the design is faulty, the application of more force produces not more pressure but simply more scrap. At moderate pressures, one commonly operates with a safety factor of 3 or 4; at very high pressures, this factor drops to 1.03 or 1.04.

The late Prof. P. W. Bridgman had grappled with manifold forms of these problems for many years and had obtained some very successful solutions.[1] Two of the many kinds of apparatus that he developed are shown in Figs. 1 and 2. These are selected because they may be regarded as prototypes for much of the high-pressure apparatus used today.

Fig. 1 shows a modified piston and cylinder employing a set of tapered supporting rings that are pushed together to support the inner cylinder as the pressure in it is increased. Such an apparatus, equipped with a cemented tungsten carbide piston, could be used for routine work at 40 kilobars and temperatures up to 200 C. Its chief weaknesses are the piston, which fails in compression, or the threaded end of the cylinder, which fails by shearing of the threads.

The seal between the piston and cylinder is made in elegant fashion by the use of the principle of unsupported area. Because selected portions of the seal are not supported, the local sealing pressures where the seal is supported are higher than the pressure inside the vessel, so that the leakage, if any, is extremely small. This principle is useful in nearly all pressure equipment.

Anvil Devices for High Pressures

Fig. 2 shows a simple anvil device in which a thin disk sample is compressed axially. The sample is only a few thousandths of an inch thick, and is restrained from radial expansion by an outer ring of pipestone.

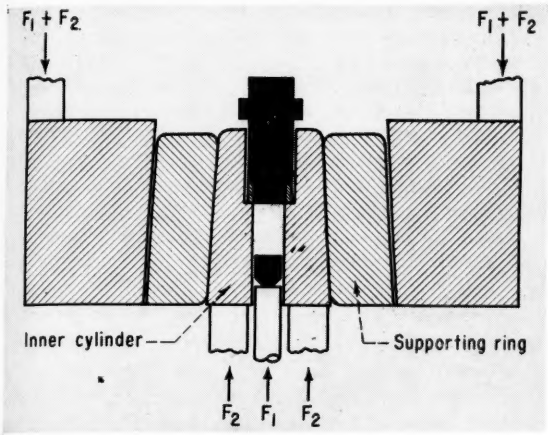


Fig. 1—Progressively-loaded piston and cylinder device in which tapered rings support inner cylinder under load.

In addition to being easily machined, it has the useful properties of being fairly compressible and of developing high shear strength while compressed. Thus, it forms a deformable, confining cylinder for the sample inside it.

Such a simple apparatus, when equipped with cemented tungsten carbide anvils, is capable of pressures of over 100 kilobars at moderate temperatures of 200 C. As the operating temperature is increased, the diminishing strength of the anvil materials reduces the pressures available. The rapid operation and low cost of the device make it or its modern variations very popular as a tool in the study of minerals.

Such a device fails usually by the splitting of the anvils caused by high local-stress gradients. A modification that minimizes this problem and permits extremely high pressures, over 400 kilobars, has been developed by H. G. Drickamer[5] at the University of Illinois. A cross-section of this apparatus is shown in Fig. 3. The sample proper is about 0.040 in. in diameter and is contained in a pyrophyllite-stone tapered annulus. This stone helps support the piston flanks and minimizes local stress gradients at high pressures. The pistons are made of cemented tungsten carbide and are work-hardened and reshaped for use at the highest pressures. Such an apparatus has permitted the study of many electronic transitions in the alkaline and rare-earth metals at very high pressures.

Another variation of this anvil apparatus shown in Fig. 4 has been used by Drickamer and his colleagues for optical studies at high pressures.[6] The sample to be studied is held between the piston faces and is surrounded by salt. The windows are also made of salt and are long and slender enough to minimize extrusion. The salt is fused in place, before a test-run, by the application of heat and pressure so that it becomes almost transparent. The sample may be heated if desired by partially surrounding it with short carbon rods heated electrically.[7] Good information about the changes of electronic optical levels with pressure has been obtained with this apparatus.

Multiple-Piston Devices for High Pressures

If instead of using two anvils bounding a plane, we use four anvils, bounding a tetrahedron, we obtain the tetrahedral apparatus developed by H. T. Hall,[8] shown in Fig. 5. All four anvils are driven by hydraulic rams toward their common center to compress a tetrahedrally shaped sample. The sample is made mostly out of pyrophyllite stone, which is compressed and partly

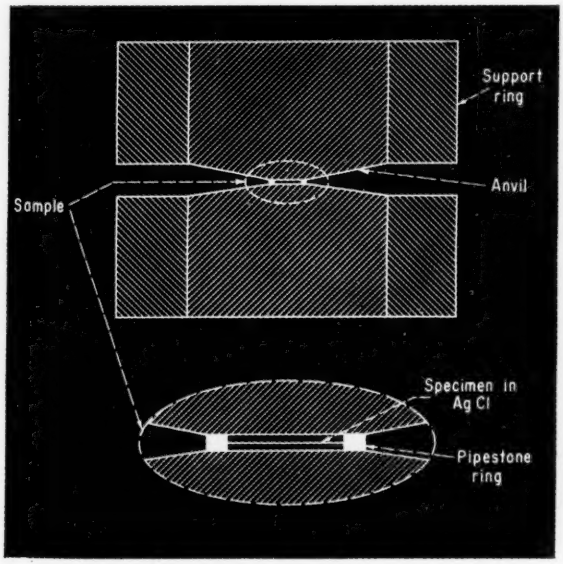


Fig. 2—Flat-anvil pressure device compresses thin disk axially while pipestone ring restrains radial expansion.

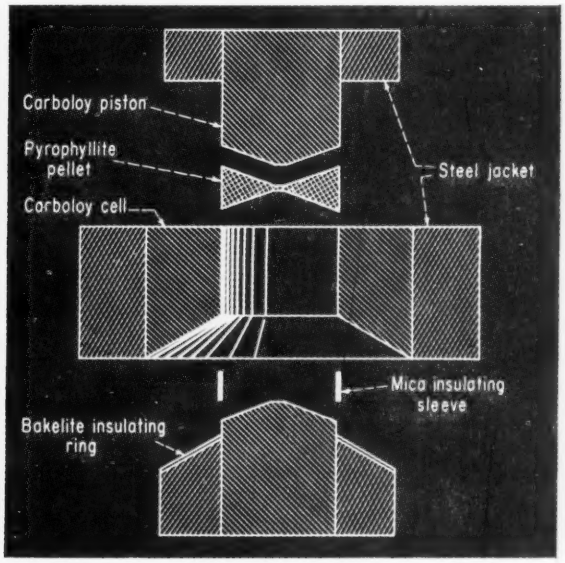


Fig. 3—Supported flat-anvil device develops highest pressure on the small central flats of the Carboloy pistons.

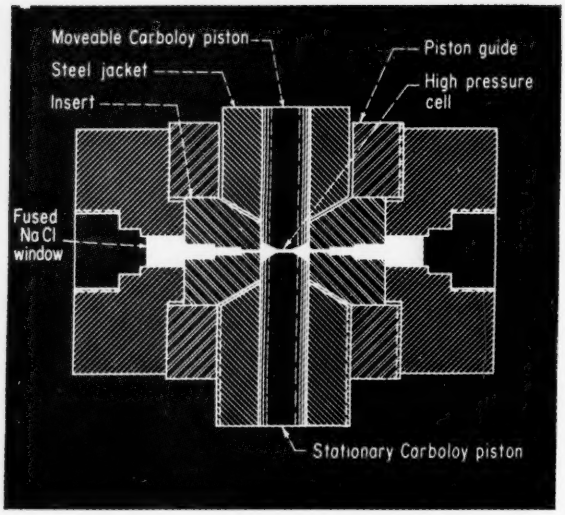


Fig. 4—Flat-anvil optical apparatus contains specimen embedded in transparent fused sodium chloride window.

extruded out of the gaps between the anvils. The friction between the stone and the flanks of the anvils helps prevent leakage of the chamber contents, and the compressibility of the stone permits motion of the anvils and compression of the sample. Inside the sample block is the reaction chamber proper, which may be heated electrically by passing current through two or more anvils. Such an apparatus is capable of maintaining 100 kilobars and 3,000 C. for many hours.

A tetrahedral apparatus similar in concept but mechanically simpler than Hall's was developed at the National Bureau of Standards by U. O. Hutton and D. P. Johnson.[9] It is illustrated in Fig. 6. Three of the four pistons slide on the conical inner wall of a heavy bucket. They slide upon thin sheets of Teflon, which provide electrical isolation and a low coefficient of friction (about 0.01). The cone angle departs from the theoretical tetrahedral angle by just enough to overcome friction. The fourth piston or anvil is pushed upon by a hydraulic press. In this way, all four anvils move toward the center of the tetrahedral sample as they are driven deeper into the bucket.

Instead of using four anvils or pistons, we may use six, arranged on the faces of a cube; or eight, arranged on the faces of an octahedron, etc. Any number of pistons greater than three may be used.

The smaller the number of pistons, the greater is the strength of each piston, but the more awkward is the shape of the chamber. The larger the number of pistons, the more nearly spherical the reaction chamber becomes, but the greater are the mechanical complexities. A number of such apparatuses, using 4, 6 or 8 pistons, are in use in various laboratories today. The six-piston, cubic arrangement is particularly convenient for studying the effects of anisotropic loading upon the mechanical behavior of rocks and other materials. It was also used by the Swedish group at ASEA in their synthesis of diamond.[10]

High-Pressure "Belt" Apparatus

Turning again toward the piston and cylinder scheme, a very successful modification has been the "Belt" apparatus[11] invented at the General Electric

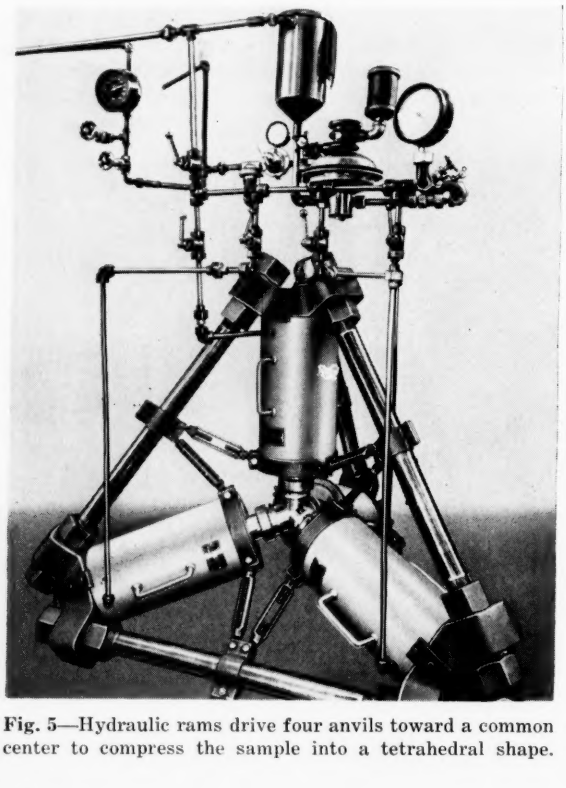


Fig. 5—Hydraulic rams drive four anvils toward a common center to compress the sample into a tetrahedral shape.

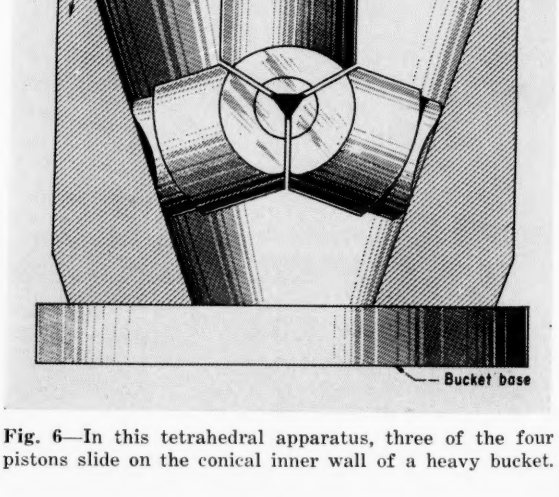


Fig. 6—In this tetrahedral apparatus, three of the four pistons slide on the conical inner wall of a heavy bucket.

Research Laboratory by H. T. Hall and others. A cross-section drawing of this apparatus is shown in Fig. 7. Two short, tapered pistons are driven into opposite ends of a short, tapered cylinder.

Both the cylinder and pistons are usually made of cemented tungsten carbide alloys and are supported by heavy steel binding rings. The variable gap between piston and cylinder is sealed by means of a compressible gasket made of a sandwich of pyrophyllite stone and steel. Although the stone is easily crushed, it is not easily extruded from the gap. Upon compression of the chamber contents to 80 kilobars, the pistons usually advance about 30% from starting positions.

The reaction chamber in this apparatus is a short central cylinder that may be heated by passing a heavy current through the pistons. The reaction chamber is insulated from the pressure chamber by refractory stone, oxides, etc. These also transmit pressure to the reaction chamber, though not truly hydrostatically on account of their finite shear strength.

Such an apparatus, when properly loaded, is capable of maintaining 100 kilobars and 3,000 C. for periods of many hours. The maximum temperatures obtainable are limited by the melting of available refractories such as zirconia, tantalum carbide, boron nitride, carbon, etc.[12]

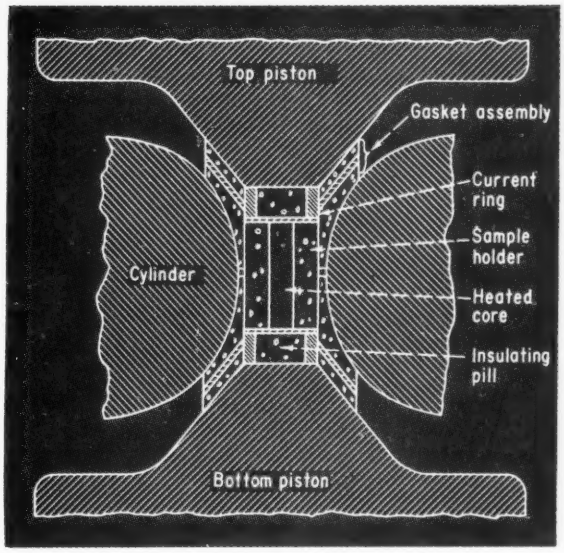


Fig. 7—High-pressure "Belt" apparatus is a modification of the piston and cylinder arrangement.

Calibration of Apparatus

The various apparatuses described here for very high-pressure work do not as a rule permit calculation of the pressures inside them by the simple ratio of force to area. Not only are the pertinent areas unknown because of distortion and flow, but the forces are also unknown because of friction.

Thus the pressures developed in such apparatuses are usually estimated by interpolation or extrapolation, using various references points as standards.[13] The pressure reference points in use are well-marked: abrupt changes of crystal structure; or electrical resistivity in certain substances, usually pure salts or metals, that take place at room temperature at certain pressures, regardless of the container.

Just as water boils at 1 atmosphere at 100 C., so does bismuth II form from bismuth I at a pressure of 25.3 kilobars at 25 C. This phase change in bismuth is accompanied by a sharp drop in electrical resistivity, as shown in Fig. 8. At a slightly higher pressure, a third form of bismuth appears that has a somewhat higher resistivity. Finally, at about 90 kilobars, the bismuth transforms to yet another phase, accompanied by a sharp drop in resistivity.

At the present time and in order to avoid confusion, the pressures reported in most high-pressure work are referred to these well-marked reference phenomena. As time goes by, the absolute pressures at which these phenomena occur will be determined more precisely. At the moment, there is not yet complete agreement among all high-pressure workers on the absolute values of these pressure reference standards, particularly for pressures above 50 kilobars where the experimental difficulties are more intense.

In order to obtain some idea of the pressures existing inside a particular piece of apparatus, the apparatus is loaded with wires or blocks of the various pressure-reference substances such as bismuth, barium, etc.; and the piston forces or deflections necessary to produce the reference phenomena are noted. In this way, we may relate the pressure inside the apparatus to the force applied to it.

The apparatus may be similarly calibrated for temperature by observing the heating power necessary to melt certain substances such as pure metals, or by reference to a thermocouple introduced into the heated zone.[13] Unfortunately, the effect of pressure upon thermocouples, although probably not greater than 10%, is unknown for temperatures much above 200 C., and again data are usually reported in terms of the particular calibration method used.

High-Explosive Shock Techniques

As mentioned earlier, it is possible to reach very high pressures for short times by using the shock phenomena produced by high explosives. J. M. Walsh and his colleagues at Los Alamos did much of the early work in this area.[14]

In these experiments, one usually places blocks of high explosive against the various materials to be studied. The explosive is set off so as to produce a well-defined detonation front. This front is driven by the hot expanding gases of the explosive at supersonic speed, and creates similar supersonic shock fronts in the materials to be studied. Typical shock-front velocities are of the order of 10 km./sec., and typical pressures produced range upward past a million bars.

The material usually remains in a compressed state for at least several microseconds. This is a time interval long enough for thousands or millions of atomic

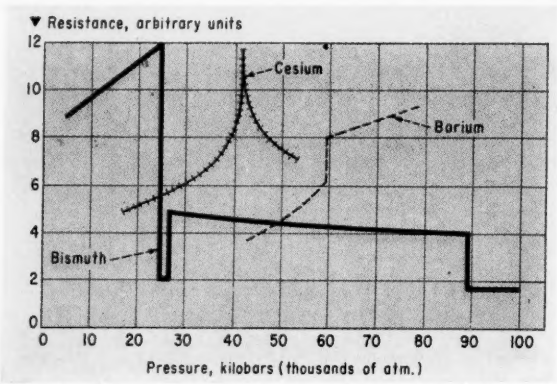
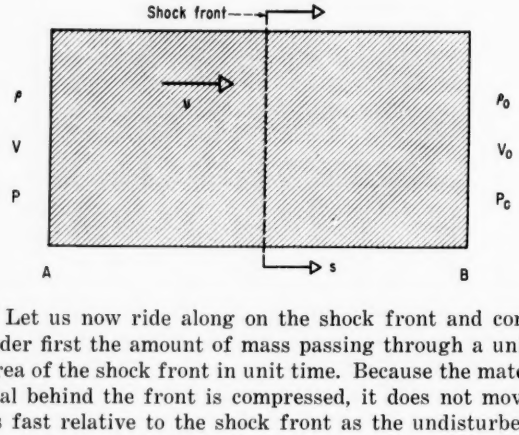


Fig. 8—Abrupt changes in the electrical resistivity of these metals serve as pressure reference standards.

vibrations in the crystal lattice. From the mechanical point of view, the shock pressures are so high that most substances may be regarded as fluid, and explosives are sometimes used today to form metal.

In the simplest case, the detonation and shock fronts are planar. If we neglect side reflection effects, it is easy to see the basic relationships in shock phenomena of this kind by using the equations of conservation of mass, energy and momentum. In the following sketch, let there be a planar shock front moving down a solid bar from A to B with supersonic velocity s. To the right of the front is undisturbed matter at rest and at pressure P_0. To the left of the front is compressed matter moving to the right with velocity u and pressure P. Let the initial density of the matter be ρ_0 and its original specific volume be V_0; let the density behind the shock front be ρ and the specific volume be V.



Let us now ride along on the shock front and consider first the amount of mass passing through a unit area of the shock front in unit time. Because the material behind the front is compressed, it does not move as fast relative to the shock front as the undisturbed matter, and we have:

$$\frac{\rho_0}{\rho} = \frac{s - u}{s} = \frac{V}{V_0} \qquad (1)$$

If momentum is conserved, then the pressure difference across the front equals the change of momentum of the material passing through the front in unit time:

$$P - P_0 = \rho_0 s u \qquad (2)$$

Notice that the pressure difference is proportional to the initial density. In most experiments, P_0 is negligible compared with P.

To obtain the energy relationship, we may imagine that the shock wave is produced and driven by a piston or high explosive at A, pushing toward B. The piston velocity is taken to be the particle velocity u, and so the rate at which the piston does work is Pu per unit area. This work appears as kinetic and internal energy of the compressed matter, which is being formed at a rate of ρ_0 per unit area. Thus, we have:

$$Pu = \rho_0 s (E - E_0) + \tfrac{1}{2} \rho_0 s u^2 \qquad (3)$$

where E and E_0 are the internal energies per unit mass of the compressed and initial material, respectively.

By substituting in Eq. (3) the value of u given by Eq. (2), and substituting in Eq. (3) the value of ρ_0 given by eliminating u between Eqs. (1) and (2), we obtain the Hugoniot equation:

$$E - E_0 = \tfrac{1}{2} (P + P_0) (V_0 - V) \qquad (4)$$

When the shock wave reaches B, the end of the bar, the entire bar is moving to the right at velocity u. Then the matter at B has no more material to push against, and so it begins to expand. If there were no friction losses, we would expect it to acquire by expansion the same increment of velocity u that it received upon compression. Thus, in most materials, the free surface B is found to move away from A at a relative velocity of very nearly u. But A is already moving at velocity u, relative to the surroundings, so that the free surface velocity is found to be very nearly $2u$.

Both the free-surface velocity $2u$ and the shock wave velocity s may be measured. Usually, we employ spaced electrical contact pins and appropriate circuitry or photographic records or both, obtained from indicator patches or argon gas heated to incandescence by the passage of a shock front. By means of the various conservation relations, Eqs. (1), (2) and (3), and a knowledge of ρ_0 and P_0 we may determine P, E and V fairly well for the compressed material behind the shock front. Thus, we may obtain that part of the equation of state $[E(P, V)]$ of the material near the Hugoniot curve. Various other reasonable assumptions, together with iterative procedures, permit fairly accurate determinations of the equation of state for pressures and densities farther removed from the Hugoniot. Ultimately, we may obtain information about the interatomic forces in the material.

Supplementing the calculations, we may obtain information about the compressed state by direct experimental methods. Since at high densities most substances tend to become more metallic, it is interesting to measure the electrical resistance or the optical spectra of the material during the brief time it is compressed. If a phase change or chemical reaction occurs in the compressed material, it will often manifest itself by the production of secondary shock fronts whose properties may be measured.

It should be noted that in a plane shock wave the material is compressed along only one axis, and local shearing occurs as the shock front passes through it.

The maximum pressures produced by shock techniques in the laboratory are about 5 million bars, and are limited by the energy available from high explosives. The pressure range may be extended by the use of multiple or reflected shocks or by permitting free-flying material to strike another surface.

By suitably stacking the specimens to be shocked, we may transfer almost all the momentum of one block of material to another block, so that it is possible to catch the first block virtually intact in water, etc., and examine at leisure the material that has been shocked.[15]

Diamond Synthesis by High-Pressure Reaction

The desire to change ordinary forms of carbon into diamond has intrigued men even since Lavoisier burned diamond to CO_2. It was recognized that diamond's greater density demanded pressure for its synthesis. This requirement is presented more explicitly in Fig. 9, which shows a phase diagram for carbon. The equilibrium line between diamond and graphite, up to 1,200 K., has been estimated from thermodynamic data by Rossini and Jessup[16] and more recently by Berman and Simon.[17] Between 1,200 and 2,300 K., the line has been extrapolated by Berman and Simon. Laboratory data on the growth and dissolution of diamond agrees fairly well with this extrapolation.

As far is is known, no diamonds have been reproducibly synthesized where graphite is stable. As we can see, fairly high pressures are required for diamond stability, particularly at higher temperatures where carbon, a refractory element, might be more reactive. It turns out that certain metals are capable of catalyzing the change from graphite to diamond under the proper conditions. These metals include manganese, iron, nickel, cobalt, palladium, platinum. The proper conditions are those where diamond is stable, and the catalyst (saturated with carbon) is molten.

In Fig. 9, the shaded area represents suitable diamond-growing conditions. It is bounded on the low-pressure side by the diamond-graphite equilibrium line, and on the low-temperature side by the melting line of the nickel-carbon eutectic.

Fig. 10 illustrates a way in which diamond synthesis may be carried out. A central cylinder of graphite is capped at each end by slugs of catalyst metal. The assembly is placed in a suitable apparatus and subjected to an appropriate pressure. Then, the assembly is heated by passing a heavy current through it. As soon as the catalyst metal melts (it is by then saturated with carbon), diamond begins to form at the interfaces between the metal and graphite. As time goes by, more diamond forms from the graphite, by means of a thin active film of catalyst metal separating the two. By-and-by, there remain only diamond and catalyst alloy. The assembly is then cooled, the pressure is removed, and the diamond-rich assembly is knocked out of the apparatus.

Fig. 11 show some freshly grown diamond, most of

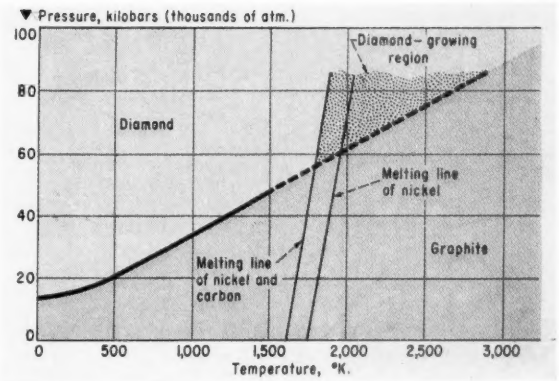


Fig. 9—Graphite-diamond equilibrium line and the nickel melting line locate the diamond forming region.

which still bears the catalytic film. The graphite has been removed, by oxidation in hot nitric and sulfuric acids. The metal film may of course be removed by acid if desired.

It is found that the kind of diamond crystals produced depends strongly on the pressures and temperatures prevailing during synthesis. At pressures far above equilibrium, the nucleation and growth rates are extremely rapid and are limited mainly by diffusion. Small, friable diamond crystals are produced, usually as fragments of octahedra.

At pressures closer to equilibrium, the nucleation and growth rates are more moderate, and nicely developed crystal faces may appear. At low synthesis temperatures, the diamonds tend to be black or dark-green in color; at higher temperatures, pale-yellow or white.

Through such control of process variables, it is possible to synthesize particular kinds of diamonds for particular uses. Sharp, polycrystalline diamonds are especially suited for grinding cemented tungsten carbide. This material regularly outperforms natural diamonds by 35% in this application. For use in metal-bonded wheels, a tougher kind of crystal is made.

Not only the mechanical but also the electrical properties of the diamonds may be controlled. The addition of small amounts of boron or aluminum to the reaction mixture produces *p*-type semiconducting diamonds. The crystals made with boron tend to be blue. Natural semiconducting diamonds, however, are extremely rare.

Mineral Syntheses by High-Pressure Reaction

In addition to diamond, there appear here and there upon the surface of the earth certain minerals that, because of their unusual density or structure, were formed deeper in the earth at high pressures. Among such minerals may be counted certain garnets, jadeite (jade) and kyanite. These minerals resisted synthesis until the early 1950's when Loring Coes[18] of Norton Co. successfully crystallized them at high pressures from mixtures of their constituent oxides and water.

His apparatus was essentially a strong, refractory

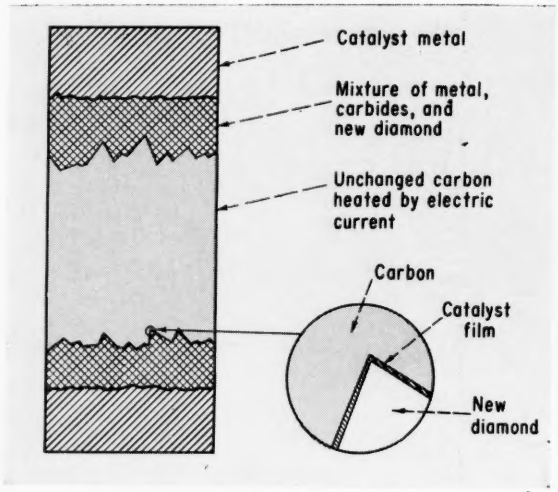


Fig. 10—High-pressure reaction chamber for diamond synthesis has cylinder of graphite and caps of catalyst metal.

Fig. 11—Freshly grown diamond crystal showing catalytic film (arrow). Graphite removed by oxidation with acids.

cylinder made of hot-pressed alumina surrounded by a steel sleeve, into each end of which was forced a sintered tungsten carbide piston. The most difficult mineral to synthesize was pyrope, the magnesium-aluminum garnet, $Mg_3Al_2(SiO_4)_3$. It required a pressure of about 27 kilobars at 600 C.

In the course of this work, Coes discovered a new, denser form of silica, named coesite, that had not been found in nature up to that time. This variety of silica forms at pressures of about 25 kilobars or higher, and once formed, is relatively stable. It differs from other forms in being rather indifferent to hydrofluoric acid. Recently, this form was found in the siliceous pulverized rock in the large meteorite craters of Arizona[19] and Ries-Kessel, Bavaria. Evidently, the high pressures and temperatures developed on the impact of the meteoroid were sufficient to form coesite.

The relatively high melting temperatures of the silicates and the small differences of free energy between their various crystalline varieties make them ideal subjects for study at high pressures. Excellent work on their formation and equilibria is being done in many laboratories, particularly the Geophysical Laboratory in Washington, D. C., and at Pennsylvania State University.

In the latter laboratory, Rustum Roy has found some interesting effects of shear on chemical reactions and phase changes at high pressures. He used an apparatus similar to that of Bridgman to study shear as shown in Fig. 12. Here, one anvil of a simple opposed-anvil set is given a slight, periodic rotation, so as to shear the sample between the anvils. It was found that the rate of approach to equilibrium was greatly hastened by added shear, particularly at lower temperatures where reactions and changes of phase are often sluggish. Since the temperature rise produced by the shearing is negligible, the enhanced reactivity must be attributed to the activation of the system by local bond rupture and re-formation during shear. It is noteworthy that Bridgman once produced by extensive shearing a thin disk of copper that was perfectly amorphous.

Some new silicates, not known in nature, have been formed at high pressures. The most interesting of these is the nickel orthosilicate spinal found by T. Ringwood. Ordinarily nickel orthosilicate has the olivine structure, like the mineral that is believed to make up much of the earth's crust. However, at higher pressures (around 60 kilobars), nickel orthosilicate assumes a more dense spinel structure. Thus, it seems possible that much of the rock at greater depths (100 to 400 miles) may exist in denser crystalline forms that are relative strangers to our low-pressure world of the surface.

It is to be noted that the pressure upon a complex system may affect the kinds of crystals that form from it, and thereby affect the kinds of chemical separations that occur as a result of the crystallization. Undoubtedly, this effect of pressure has played some role in the preparation of the various kinds of rocks found on the earth, and in the building of continents.

Black Phosphorus by High-Pressure Reaction

As we know, phosphorus may exist in several different forms: white, red or black. White phosphorus may be regarded as an assembly of P_4 molecules held together by weak intermolecular forces. Red phosphorus, on account of its relative insolubility in carbon disulfide, etc., evidently contains much larger molecules than P_4, but its crystal structure is not completely known. Black phosphorus, the densest form, has a graphite-like structure containing large sheets of atoms. The types of bonding that exist in the various modifications of phosphorus make each modification in effect a separate chemical species.

Black phosphorus was discovered by P. W. Bridgman in 1914 as the result of high-pressure studies on phosphorus.[1] The low vapor-pressure of black phosphorus implied that it is the most stable form, and for many years it was believed that pressures of at least 12 kilobars were necessary for its formation. However, Krebs[20] has shown that it may be prepared from a finely divided mixture of red phosphorus and mercury at 1 atm. and 360 C.

Because black phosphorus is a semiconductor, it is interesting to attempt to prepare crystals of it. This is conveniently done by cooling a melt of phosphorus at a pressure sufficiently high (25 kilobars) for the black form to be stable.

To begin with, white phosphorus is cast into a titanium tube. This is enclosed in a refractory stone holder and placed inside a "Belt" pressure apparatus. After the pressure is increased to 25 kilobars, the phosphorus is heated by passing a heavy current through the tube. Then the current is decreased slowly so as to permit the capsule to cool. The phosphorus freezes from the ends toward the middle. After cooling and pressure reduction, the titanium may be removed by hydrofluoric acid to leave ingots of black phosphorus.

Formation of Cubic Boron Nitride

The similarities between graphite and hexagonal boron nitride are so striking that a search for a cubic form of boron nitride that would be analagous to diamond was carried out. It was found that this substance could be prepared at high pressures and temperatures starting from a mixture of hexagonal boron nitride and a suitable catalyst.[21] Such catalysts are lithium, magnesium, calcium, etc., and their nitrides. Cubic boron nitride may also be prepared at high pressures from mixtures of boron, nitrogen and catalyst.

A typical reaction vessel is shown in Fig. 13. A mixture of boron nitride and catalyst is tamped into a refractory conducting tube, which is then placed in a high-pressure apparatus. After the pressure has been increased to about 45-80 kilobars, the capsule is electrically heated, to about 1,600-2,000 C.

Then, the catalyst lumps melt and diffuse into the boron nitride, and cubic BN begins to form. After the reaction is completed—usually in a few minutes—the temperature and then the pressure are reduced, and the capsule contents are treated with hydrochloric acid to permit easy separation of the cubic BN crystals.

As with diamond, the nucleation and growth rates of cubic BN depend strongly upon the amount by which the synthesis pressure exceeds the equilibrium pressure at the synthesis temperature. Extremely small crystals are produced very rapidly when pressure is a few kilobars above equilibrium. The synthesis temperature influences the crystal color; higher temperatures produce paler colored crystals.

By observing the growth and dissolution of seed crystals, we may estimate the course of a portion of the hexagonal-cubic equilibrium line for boron nitride. It is shown in Fig. 14—with the diamond-graphite line included for comparison. It will be noted that cubic BN is somewhat more stable than diamond at most temperatures. Cubic BN also resists oxidation better than diamond.

Cubic BN has the zinc-blende cubic structure (like diamond but with alternate kinds of atoms) with the edge length of a unit cell being 3.615Å (vs. 3.56Å for diamond). It is not surprising then that it is substantially as hard as diamond. Ordinarily, cubic BN, like diamond, is an electrical insulator.

Although cubic BN is difficult to analyze chemically, the X-ray evidence indicates that the crystals have nearly stoichiometric composition. It is possible to incorporate selected impurities in the crystals by adding impurities to the starting mixture. If beryl-

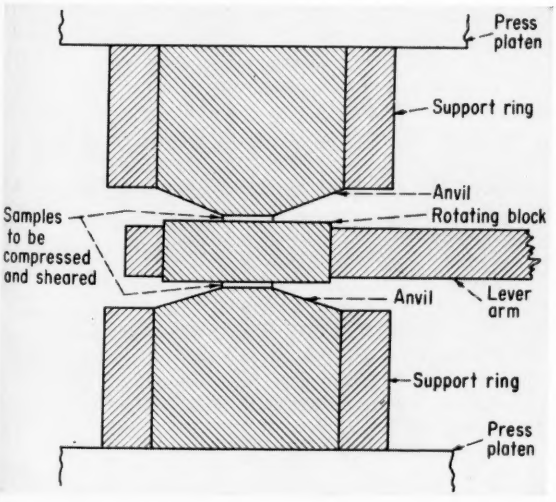


Fig. 12—Flat-anvil apparatus of Bridgman modified to give rotation of sample and shear it between the anvils.

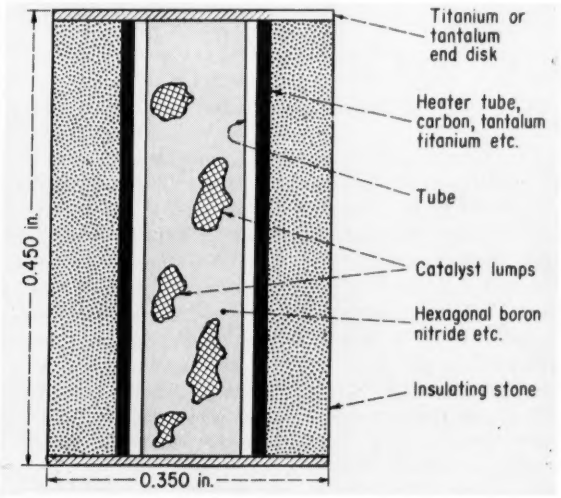


Fig. 13—Reaction vessel has inner refractory conducting tube for preparing cubic boron nitride under pressure.

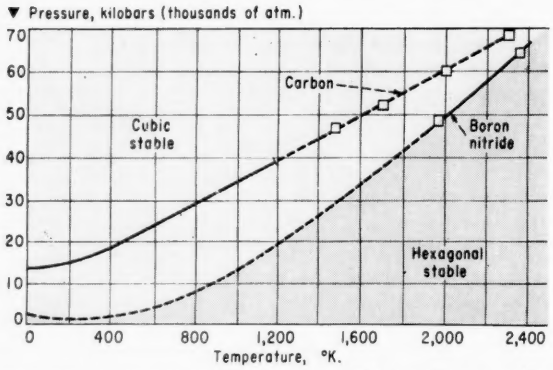


Fig. 14—Hexagonal-cubic phase equilibrium line provides the pressures necessary to form cubic boron nitride.

lium is added, the crystals become blue *p*-type semiconductors. If sulfur, silicon or a number of carbon-and-nitrogen-containing substances are added, the crystals formed are yellow or brown *n*-type semiconductors. The energy difference between the valence band and the conduction band in cubic BN is large, as in diamond, and is on the order of 5 electron-volts. In this comparatively wide gap, there may exist a diversity of energy levels corresponding to various crsytal imperfections and impurities, and the electronic behavior of the crystals is correspondingly complex.

Formation of Cubic Boron Sulfide

One of the recent additions to the roster of high-pressure compounds is a cubic form of BS prepared by H. T. Hall.[22] These crystals are made at 80 kilobars and 2,000 C. from boron and sulfur, have a zinc-blende lattice with a unit cell edge length of 4.33Å, and are transparent semiconductors. The two other well-known sulfides of boron, B_2S_3 and B_2S_5, are prepared at low pressures. Cubic BS, like cubic BN, illustrates the tendency of boron atoms to form stable electronic octets if sufficiently pushed. In both these substances, each B atom is bonded to its four nearest atoms.

Future Growth of High-Pressure Chemistry

It is clear that if very high pressures are to be used in industrial processes, the products of these processes will have to be extremely valuable on a weight or volume basis, because investment in apparatus is high, the highly stressed portions of the apparatus are not usually long-lived, and the capacity is low. Today, the best applications for high-pressure processes would appear to be in the fields of superior abrasives, electronic specialties, or possibly pharmaceuticals.

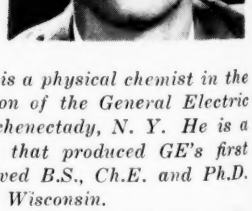
I am told that engineers strive to replace batch processes by continuous processes whenever possible. At the moment, nearly all high-pressure work above 5 kilobars is conducted on a batch basis. Although there appear to be definite possibilities for continuous processes using pressures as high as 15 kilobars, the relative weakness and elasticity of the available materials of construction, as well as the frequent need for thermal insulation, have so restricted the design of apparatus that only batch processes are employed for the higher pressures. For the same reasons, it is often difficult to introduce volatile or gaseous reactants, or to control the rate of entry of reactants.

In the future, we may expect that more new compounds peculiar to high pressure will be discovered as the influence of pressure on the shifting of chemical equilibria is exploited. We may also expect new benefits from the greater understanding of the structure of matter obtained from high-pressure studies.

References

1. Bridgman, P. W., "The Physics of High Pressure," G. Bell & Sons, London, 1949.
2. Bundy, F. P., H. T. Hall, H. M. Strong and R. H. Wentorf, Jr., *Nature*, **176**, 51 (1955); **184**, 1094 (1959).
3. Balchan, A. S. and H. G. Drickamer, *Rev. Sci. Inst.*, (In Press), (1961).
4. McQueen, R. G. and S. P. Marsh, *J. Appl. Phys.*, **31**, 1253 (1960).
5. Bundy, F. P., *Phys. Rev.*, **110**, 314 (1958).
6. Slykhouse, T. E. and H. G. Drickamer, *J. Phys. Chem. Solids*, **7**, 207 (1958).
7. Balchan, A. S. and H. G. Drickamer, *Rev. Sci. Inst.*, **31**, 511 (1960).
8. H. T. Hall, *Rev. Sci. Instr.*, **29**, 267 (1958).
9. Lloyd, E. C., U. O. Hutton and D. P. Johnson, *J. Res. Nat. Bur. Stds.*, **63c**, 59 (1959).
10. Liander, H. and E. Lundblad, *Arkiv for Kemi*, **16**, No. 9, 139 (1960).
11. Hall, H. T., *Rev. Sci. Instr.*, **31**, 125 (1960).
12. Wentorf, Jr., R. H., *J. Phys. Chem.*, **63**, 1934 (1959).
13. Wentorf, Jr., R. H., "Modern High Pressure Techniques," (In Press), Butterworths, London, 1961; "Progress in Very High Pressure Research," (In Press), Wiley, New York (1961).
14. Rice, M. H., R. G. McQueen and J. M. Walsh, "Compression of Solids by Strong Shock Waves," Solid State Physics, Vol. VI, pp. 47-60, Academic Press, New York, 1957.
15. Smith, C. S., *Trans. Metallurg. Soc. of AIME*, 574 (1958); DeCarli, P. S. and J. C. Jamieson, *J. Chem. Phys.* **31**, 1675 (1959).
16. Rossini, F. D. and R. S. Jessup, *J. Res. Nat. Bur. Stand.*, **21**, 491 (1938).
17. Berman and Simon, *Z. Electrochemie*, **59**, 333 (1955).
18. Coes, Jr., L., *J. Am. Ceramic Soc.*, **58**, No. 8, 298 (1955).
19. Chao, E. C. T., E. M. Shoemaker and B. M. Madsen, *Science*, **132**, 220 (1960).
20. Krebs, H., H. Weitz and K. H. Worms, *Z. Anorg. u. Allg. Chem.*, **280**, 119 (1955).
21. Wentorf, Jr., R. H., *J. Chem. Phys.*, **34**, 809 (1961).
22. Hall, H. T., Paper presented ACS meeting Cleveland, Ohio, April 1960.

Meet the Author



ROBERT H. WENTORF, JR., *is a physical chemist in the mechanical investigations section of the General Electric Co. Research Laboratory at Schenectady, N. Y. He is a member of the research team that produced GE's first man-made diamonds. He received B.S., Ch.E. and Ph.D. degrees from the Universtiy of Wisconsin.*

Dr. Wentorf is a member of Tau Beta Pi and Sigma Xi. During World War II, he served in the U. S. Navy. His hobbies are music, skiing, geology and photography.

CE Refresher

Estimate Transport Coefficients

This article presents methods recommended for estimating transport coefficients for viscosity, thermal conductivity or diffusivity that are necessary whenever solving problems involving transport phenomena.

L. DOUGLAS SMOOT, *Brigham Young University*

When solving problems in mass, heat and momentum transport, it is usually necessary to know the values of the transport coefficients for viscosity, thermal conductivity and diffusivity. Occasionally, experimental values[1, 13, 14] for these coefficients are available.

This review shows the best methods for estimating the transport coefficients for simple gases and liquids at moderate pressures. The information was mostly taken from Gambill[2-8] and Reid and Sherwood.[14] Gambill has reported an extensive survey of techniques for estimating thermal conductivity, viscosity and diffusivity for gases and liquids in a variety of conditions. The methods include those for mixtures, high pressure and temperature, and other special cases.

Reid and Sherwood have organized an extensive review of experimental data and equations, to predict transport coefficients. Comparisons of the experimental data with several of the best estimating techniques are shown for each of the coefficients of interest. Specific references to the methods presented here can be found in the publications of Gambill, and Reid and Sherwood.

Viscosity of Gases and Liquids

The method of Hirschfelder is recommended for predicting gas viscosity at low or moderate pressures.

$$\mu = \frac{0.0026693(MT)^{0.5}}{\sigma^2 \Omega_v} \qquad (1)$$

where μ = viscosity, cp.; M = molecular weight; T = absolute temperature, °K.; σ = collision diameter, angstrom; Ω_v = collision integral obtained from Table I as a function of kT/ϵ; k = Boltzman constant (1.38×10^{-16}), erg/°K and ϵ = potential parameter in Lennard-Jones potential model, erg.

Values of ϵ/k and σ are given in Table II for a number of common gases. Accuracy of viscosities estimated with Eq. (1) is within 1 to 3%.

Bromley and Wilke modified Eq. (1) by using empirical means to predict k/ϵ and σ to obtain:

$$\mu = \frac{0.00333(MT)^{0.5} f_1(1.33T_r)}{V_c^{2/3}} \qquad (2)$$

where T_c = critical temperature, °K.; T_r = reduced temperature, T/T_c; V_c = critical volume, cm.³/g.-mole and $f_1(1.33T_r)$ = function obtained from Table I where kT/ϵ is approximated by $1.33T_r$, and other symbols are as defined for Eq. (1).

The advantage of this method is that is does not require values of ϵ/k or σ. Eq. (2) predicted 270 experimental viscosities with an average deviation of 3.2%.

Reid and Sherwood[14] and Gambill[9, 10] also present methods for predicting viscosities of gases at high pressures, and viscosities of gas mixtures.

Example 1—Estimate the viscosity of methane at 300 C. and 1 atm., and compare with the experimental value of 0.185 cp.

From Table II, we find ϵ/k = 136.5 K., and σ equivalent to 3.822 angstroms. Here, kT/ϵ = (300 + 273)/136.5, or 4.20. From Table I, we find Ω_v = 0.96. Substituting these values into Eq. (1) gives a value for μ of 0.182 cp. Hence, error, compared with experimental value, is 1.6%.

No reliable methods are available for estimation of

To meet your author, see *Chem. Eng.*, Sept. 18, 1961, p. 186.

liquid viscosities in the absence of experimental data. If a minimum of two experimental data points are available, then viscosities can be determined accurately for a wide range of temperatures by evaluating the constants A and B in the equation:

$$\mu = Ae^{B/T} \quad (3)$$

where μ is viscosity and T is the absolute temperature. The units will be the same as the data for which A and B are evaluated. Accuracy is generally within 1%.

When no experimental data are available, the method of Thomas, reported by Gambill,[7] appears to be the most reliable:

$$\mu = (0.1167\rho_L^{0.5})10^a \quad (4a)$$

$$a = B(1 - T_r)/T_r \quad (4b)$$

where μ = viscosity of liquid, cp.; ρ_L = density, g./cm.^{3}; T_r = reduced temperature, T/T_c; and B is a viscosity constant calculated from atomic and group contributions of Table III. Eq. (4) predicts viscosities with an average error of 20 to 30%.

Example 2—Estimate the viscosity of chlorobenzene at 40 C. and compare with the experimental value of 0.639 cp. Here, ρ_L = 1.11 g./ml., and T_c = 359.2 C.

From the structural contributions in Table III, we find: $B = 0.340 + 0.385 = 0.725$.

Reduced temperature $T_r = (273 + 40)/(273 + 359.2)$, or 0.495. Substituting in Eq. (4b), we find a equal to 0.740. We can now solve Eq. (4a) to find the value for μ as 0.677 cp. Therefore, error is 5.9%.

Methods for predicting viscosities at high pressures and for liquid mixtures are also available in the literature.[11, 12, 14]

Values of viscosity collision integral and temperature function—Table I

(Based on Lennard-Jones potential)

kT/ϵ	Ω_v	$f_1(kT/\epsilon)$	kT/ϵ	Ω_v	$f_1(kT/\epsilon)$
0.30	2.785	0.1969	2.7	1.069	1.5417
0.35	2.628	0.2252	2.8	1.058	1.5861
0.40	2.492	0.2540	2.9	1.048	1.6298
0.45	2.368	0.2834	3.0	1.039	1.6728
0.50	2.257	0.3134	3.1	1.030	1.7154
0.55	2.156	0.3440	3.2	1.022	1.7573
0.60	2.065	0.3751	3.3	1.014	1.7983
0.65	1.982	0.4066	3.4	1.007	1.8388
0.70	1.908	0.4384	3.5	0.9999	1.8789
0.75	1.841	0.4704	3.6	0.9932	1.9186
0.80	1.780	0.5025	3.7	0.9870	1.9576
0.85	1.725	0.5346	3.8	0.9811	1.9962
0.90	1.675	0.5666	3.9	0.9755	2.0343
0.95	1.629	0.5985	4.0	0.9700	2.0719
1.00	1.587	0.6302	4.1	0.9649	2.1090
1.05	1.549	0.6616	4.2	0.9600	2.1457
1.10	1.514	0.6928	4.3	0.9553	2.1820
1.15	1.482	0.7237	4.4	0.9507	2.2180
1.20	1.452	0.7544	4.5	0.9464	2.2536
1.25	1.424	0.7849	4.6	0.9422	2.2888
1.30	1.399	0.8151	4.7	0.9382	2.3237
1.35	1.375	0.8449	4.8	0.9343	2.3583
1.40	1.353	0.8744	4.9	0.9305	2.3926
1.45	1.333	0.9036	5.0	0.9269	2.4264
1.50	1.314	0.9325	6.0	0.8963	2.751
1.55	1.296	0.9611	7.0	0.8727	3.053
1.60	1.279	0.9894	8.0	0.8538	3.337
1.65	1.264	1.0174	9.0	0.8379	3.607
1.70	1.248	1.0453	10	0.8242	3.866
1.75	1.234	1.0729	20	0.7432	6.063
1.80	1.221	1.0999	30	0.7005	7.880
1.85	1.209	1.1264	40	0.6718	9.488
1.90	1.197	1.1529	50	0.6504	10.958
1.95	1.186	1.1790	60	0.6335	12.324
2.00	1.175	1.2048	70	0.6194	13.615
2.1	1.156	1.2558	80	0.6076	14.839
2.2	1.138	1.3057	90	0.5973	16.010
2.3	1.122	1.3547	100	0.5882	17.137
2.4	1.107	1.4028	200	0.5320	26.80
2.5	1.093	1.4501	400	0.4811	41.90
2.6	1.081	1.4962			

• From J. O. Hirschfelder, C. F. Curtiss, and R. B. Bird, "Molecular Theory of Gases and Liquids", Wiley, New York, 1954; and L. A. Bromley and C. R. Wilke, *Ind. Eng. Chem.*, 43, 1641 (1951).

Thermal Conductivity of Gases and Liquids

Bromley's correlation is recommended for estimating the thermal conductivity of pure gases at low pressures.

For monatomic gases:

$$k = 2.5\mu C_v/M \quad (5a)$$

For linear molecules:

$$k = (\mu/M)[1.32C_v + 3.40 - (0.70/T_r)] \quad (5b)$$

where k = thermal conductivity, cal./(sec.) (cm.) (°C.); μ = viscosity, poise; C_v = heat capacity, cal./(g.-mole) (°C.); M = molecular weight; and T_r = reduced temperature, T/T_c.

An equation for nonlinear molecules is also presented.[14] Average error for Eqs. (5a) and (5b) is about 4%.

Example 3—Estimate the thermal conductivity of chlorine at 0 C. and 1 atm. Compare the result with the experimental value of 1.78×10^{-5} cal./(sec.) (cm.) (°C.). Additional data are:

$\mu = 1.19 \times 10^{-4}$ poise.
$C_v = 6.06$ cal./(g.-mole)(°C.).
$M = 71$.
$T_r = T/T_c = 273/417 = 0.655$.

Since chlorine is a linear molecule, Eq. (5b) is used. After substituting appropriate values into Eq. (5b) and solving, we get k as 1.75×10^{-5} cal./(sec.) (cm.) (°C.). This represents an error of 1.7%.

The accuracy of estimation can be increased if one value of k is known. Methods for estimating thermal conductivities at high pressures, and for gas mixtures, are available [4, 14] but reliability is poor.

For estimating the thermal conductivity of a pure liquid, the method of Weber is simple and relatively accurate:

Lennard-Jones force constants—Table II

Compound	ϵ/k, °K.	σ, A.
Acetylene	185	4.221
Air	97	3.617
Argon	124	3.418
Arsine	281	4.06
Benzene	440	5.270
Bromine	520	4.268
i-Butane	313	5.341
n-Butane	410	4.997
Carbon dioxide	190	3.996
Carbon disulfide	488	4.438
Carbon monoxide	110	3.590
Carbon tetrachloride	327	5.881
Carbonyl sulfide	335	4.13
Chlorine	357	4.115
Chloroform	327	5.430
Cyanogen	339	4.38
Cychohexane	324	6.093
Ethane	230	4.418
Ethanol	391	4.455
Ethylene	205	4.232
Fluorine	112	3.653
Helium	10.22	2.576
n-Heptane	282*	8.88*
n-Hexane	413	5.909
Hydrogen	33.3	2.968
Hydrogen chloride	360	3.305
Hydrogen iodide	324	4.123
Iodine	550	4.982
Krypton	190	3.61
Methane	136.5	3.822
Methanol	507	3.585
Methylene chloride	406	4.759
Methyl chloride	855	3.375
Mercuric iodide	691	5.625
Mercury	851	2.898
Neon	35.7	2.789
Nitric oxide	119	3.470
Nitrogen	91.5	3.681
Nitrous oxide	220	3.879
n-Nonane	240	8.448
n-Octane	320	7.451
Oxygen	113	3.433
n-Pentane	345	5.769
Propane	254	5.061
Sulfur dioxide	252	4.290
Water	356	2.646
Xenon	229	4.055

From J. O. Hirschfelder, R. B. Bird and E. L. Spotz, *Chem. Reviews*, 44, 205 (1949); J. O. Hirschfelder, R. B. Bird and E. L. Spotz, *Trans. ASME*, 71, 921 (1949); J. O. Hirschfelder, C. F. Curtiss and R. B. Bird, "Molecular Theory of Gases and Liquids," Wiley, New York, 1954; J. S. Rowlinson and J. R. Townley, *Trans. Faraday Soc.*, 49, 20 (1953).
* Calculated from virial coefficients.

$$k = 3.59 \times 10^{-3} C_p \rho (\rho/M)^{1/3} \qquad (6)$$

where k = thermal conductivity, cal./(sec.) (cm.) (°C.); ρ = density, g/cm.^{3}; C_p = heat capacity, cal./(g.) (°C.), and M = molecular weight.

Eq. (6) predicted 89 experimental values of thermal conductivity with an average error of 13%. The more complicated method of Sakiadis and Coates—reported by Gambill,[2] and Reid and Sherwood[14]—has a better theoretical basis, but the accuracy is slightly less than that of Eq. (6). Gambill[2] discusses methods available for predicting k values for liquid mixtures.

Example 4—Estimate the thermal conductivity of benzene at 50 C. and compare with the experimental value of 3.28×10^{-4} cal./(cm.) (sec.) (°C.). Use $M = 78$, $\rho = 0.879$ g./cm.^{3}, and $C_p = 0.435$ cal./(g.) (°C.).

Substituting appropriate values into Eq. (6) and solving for k gives the value as 3.07×10^{-4} cal./(sec.) (cm.) (°C.). Compared with the experimental value, the error is 6.4%.

Diffusion Coefficients for Gases and Liquids

For binary gas systems at low pressure, Hirschfelder's method, based on the kinetic theory of gases, gives excellent results:

$$D_{12} = \frac{0.001858 T^{3/2} \sqrt{\dfrac{M_1 + M_2}{M_1 M_2}}}{P \sigma_{12}^2 \Omega_D} \qquad (7)$$

D_{12} = Diffusivity of component 1 in a mixture of 1 and 2, cm^2/sec
T = Absolute temperature, °K.
M_1 = Molecular weight of 1.
M_2 = Molecular weight of 2.
P = Total pressure, atm.
$\sigma_{12} = \frac{1}{2}(\sigma_1 + \sigma_2)$ where σ_1 and σ_2 are the collision diameters of 1 and 2, respectively, angstrom.
Ω_D = Collision integral for diffusion obtained from Table IV as a function of kT/ϵ_{12}.
$\epsilon_{12} = (\epsilon_1 \epsilon_2)^{0.5}$

Values of force constants σ and ϵ are obtained from Table II as before. Approximate methods for estimating σ and ϵ are available.[14] This method predicted experimental D_{12} values for 80 systems with an average error of only 6%. When force constants are not obtainable, the method of Arnold shown in Reid and Sherwood[14] and Gambill[5] gives satisfactory results.

For pressures above about 15 atm., no reliable

Structural contributions for calculating B in Eq. (4b)—Table III

Carbon	−0.462
Hydrogen	0.249
Oxygen	0.054
Chlorine	0.340
Bromine	0.326
Iodine	0.335
Sulfur	0.043
C_6H_5	0.385
Double Bond	0.478
CO (ketones, esters)	0.105
CN (cyanides)	0.381

methods exist for estimating D_{12}. Diffusion coefficients in multicomponent systems can be theoretically predicted once the binary values are known.[5]

Example 5—Estimate the diffusivity of oxygen in an oxygen-nitrogen mixture at 0 C. and 1 atm. and compare with the experimental value of 0.181 cm.²/sec. Let 1 represent the oxygen, 2 the nitrogen.

Using Table II, we find $\sigma_{12} = \frac{1}{2}(3.43 + 3.68) = 3.56$; $\epsilon_1/k = 113$; $\epsilon_2/k = 91.5$. Hence, we can calculate ϵ_{12}/k as $[(113)\ (91.5)]^{0.5} = 101.6$, and kT/ϵ_{12} as $273/101.6 = 2.69$.

From Table IV, we find by interpolation the value for Ω_D as 0.980, which corresponds to kT/ϵ of 2.69. Substituting in Eq. (7) and solving for the diffusion coefficient gives the value for D_{12} as 0.174 cm.²/sec. The calculated value is in error by 5.5%.

The diffusion coefficient for liquids is a function of concentration and can only be estimated accurately for dilute solutions. In addition, ionization, dissociation or association of compounds in solution makes prediction of diffusivity even more difficult.

Diffusion collision integral—Table IV

(Based on Lennard-Jones potential)

kT/ϵ	Ω_D	kT/ϵ	Ω_D	kT/ϵ	Ω_D
0.30	2.662	1.55	1.182	3.6	0.9058
0.35	2.476	1.60	1.167	3.7	0.8998
0.40	2.318	1.65	1.153	3.8	0.8942
0.45	2.184	1.70	1.140	3.9	0.8888
0.50	2.066	1.75	1.128	4.0	0.8836
0.55	1.966	1.80	1.116	4.1	0.8788
0.60	1.877	1.85	1.105	4.2	0.8740
0.65	1.798	1.90	1.094	4.3	0.8694
0.70	1.729	1.95	1.084	4.4	0.8652
0.75	1.667	2.00	1.075	4.5	0.8610
0.80	1.612	2.1	1.057	4.6	0.8568
0.85	1.562	2.2	1.041	4.7	0.8530
0.90	1.517	2.3	1.026	4.8	0.8492
0.95	1.476	2.4	1.012	4.9	0.8456
1.00	1.439	2.5	0.9996	5.0	0.8422
1.05	1.406	2.6	0.9878	6	0.8124
1.10	1.375	2.7	0.9770	7	0.7896
1.15	1.346	2.8	0.9672	8	0.7712
1.20	1.320	2.9	0.9576	9	0.7556
1.25	1.296	3.0	0.9490	10	0.7424
1.30	1.273	3.1	0.9406	20	0.6640
1.35	1.253	3.2	0.9328	30	0.6232
1.40	1.233	3.3	0.9256	40	0.5960
1.45	1.215	3.4	0.9186	50	0.5756
1.50	1.198	3.5	0.9120	60	0.5596
				70	0.5464
				80	0.5352
				90	0.5256
				100	0.5130
				200	0.4644
				400	0.4170

From J. O. Hirschfelder, C. F. Curtiss, and R. B. Bird, "Molecular Theory of Gases and Liquids", Wiley, New York, 1954.

Liquid diffusion solvent association parameters—Table V

Solvent	Association Parameter
Water	2.6
Methanol	1.9
Ethanol	1.5
Benzene	1.0
Ether	1.0
Heptane	1.0
Unassociated solvents	1.0

The method of Wilke and Chang allows prediction of D_{12} for dilute nonelectrolyte solutions with an average error of about 10%.

$$D_{12} = \frac{7.4 \times 10^{-8}(\chi M)^{0.5} T}{\mu V_1^{0.6}} \qquad (8)$$

D_{12} = Diffusivity of dilute solute 1 in solvent 2, cm.²/sec.
M = Molecular weight of solvent.
T = Absolute temperature, °K.
μ = Viscosity of the solution, cp.
V_1 = Molar volume of the solute at the normal boiling point, cm.³/g.-mole.
χ = Association parameter of the solvent as shown in Table V.

Methods of predicting diffusivities for concentrated solutions and electrolytes are available.[6]

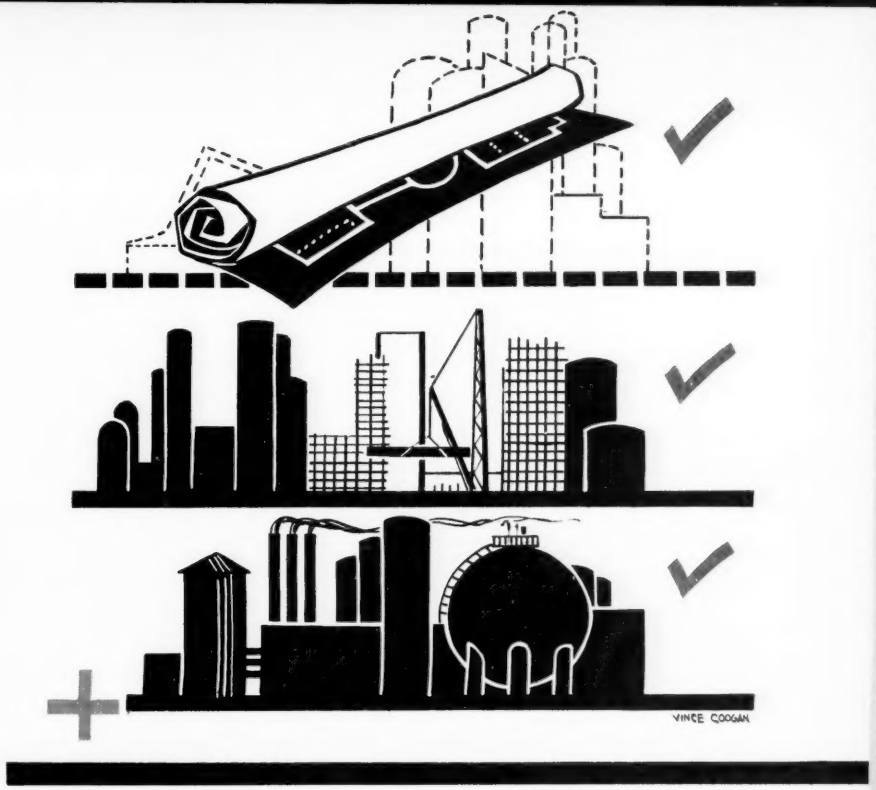
Example 6—Estimate the diffusivity of a very dilute solution of carbon tetrachloride in liquid methanol at 15 C. Compare this value with the experimental value of 1.70×10^{-5} cm.²/sec. Additional data are $M = 32$, $\chi = 1.9$ from Table V, $T = 288$ K., $\mu = 0.65$, which is equal to that of solvent for very dilute solutions, and $V_1 = 113.2$ cm.³/g.-mole (calculated from density).

By substituting into Eq. (8), we calculate the diffusion coefficient D_{12} to be 1.49×10^{-5} cm.²/sec. This value compared with the experimental data is 12% in error.

The methods given here for estimating transport coefficients are those currently recommended for the simple gases and liquids. Caution must be exercised when using any of these equations at high pressures or under any unusual circumstances. See Sherwood and Reid[14] and Gambill[2 to 12] for further details.

References

1. Bird, R. B., W. E. Stewart and E. N. Lightfoot, "Transport Phenomena," Wiley, New York, 1960.
2. Gambill, W. R., *Chem. Eng.*, Feb. 1957, p. 237.
3. Gambill, W. R., *Chem. Eng.*, Mar. 1957, p. 271.
4. Gambill, W. R., *Chem. Eng.*, Apr. 1957, p. 277.
5. Gambill, W. R., *Chem. Eng.*, June 2, 1958, p. 125.
6. Gambill, W. R., *Chem. Eng.*, June 30, 1958, p. 113.
7. Gambill, W. R., *Chem. Eng.*, Sept. 22, 1958, p. 169.
8. Gambill, W. R., *Chem. Eng.*, Jan. 12, 1959, p 127.
9. Gambill, W. R., *Chem. Eng.*, Oct. 20, 1958, p. 157.
10. Gambill, W. R., *Chem. Eng.*, Nov. 17, 1958, p. 157.
11. Gambill, W. R., *Chem. Eng.*, Mar. 9, 1959, p 151.
12. Gambill, W. R., *Chem. Eng.*, Feb. 9, 1959, p. 123.
13. Perry, J. H., "Chemical Engineers' Handbook," 3rd. Ed., McGraw-Hill, New York 1950.
14. Reid, R. C. and T. K. Sherwood, "The Properties of Gases and Liquids," McGraw-Hill, New York, 1958.



Semiannual Inventory of New Plants & Facilities

On this and the ten pages that follow are tabulated almost 550 chemical process industry projects that have been in the news during the period from February through July 1961. The table covers projects that are planned, under construction, or recently completed—in many cases, updating earlier listed projects.

These listings have been compiled from many sources and, so far as feasible, have been checked for accuracy, completeness and current status. Only major projects—over $200,000—have been included.

This is the 13th such tabulation issued by CHEMICAL ENGINEERING. Our previous tabulations, covering projects earlier than those listed here, appeared in the February issues of 1951, 1952 and 1953; in January 1954; in our Inventory Issues of 1955, 1956 and 1957; in regular issues of May 4, 1959, April 18, 1960, October 17, 1960 and April 17, 1961.

Fertilizers

Company	Location	Products	Capacity	Status and Remarks
Allied Chemical Corp.	East St. Louis, Ill.	Phosphoric acid	50,000 tons/yr.	Wet-process plant on stream.
American Humates Inc.	Glenrock, Wyo.	Concentrated humus grains	75 tons/day	Planned unit will use coal as feedstock.
American Metal Climax, Inc.	Vicksburg, Miss.	Potassium nitrate		$7-million plant, due on stream late 1961, will use undisclosed process in making potassium nitrate for fertilizer use.
Armour Agricultural Chemical Co.	Cherokee, Ala.	Ammonia	360 tons/day	Due completed early 1962; part of a $60-million project that includes facilities in Polk County, Fla.
		Urea	50 tons/day	
		Ammonium nitrate prills	250 tons/day	
		Nitrogen solutions	250 tons/day	
		Nitric acid	300 tons/day	
		Ammonium phosphate	500 tons/day	
Armour Agricultural Chemical Co.	Polk County, Fla.	Sulfuric acid, phosphoric acid, triple superphosphate		Due completed 1962.
Bunker Hill Co.	Kellogg, Idaho	Phosphoric acid	130 tons/day	$2-million plant on stream.
Bunker Hill Co.	Kellogg, Idaho	Phosphoric acid, concentrated		$225,000 plant completed to produce highly concentrated wet-process acid.
California Chemical Co.	Fort Madison, Iowa	Dry complex fertilizers	600 tons/day	Due on stream late 1961.
Coastal Chemical Corp.	Pascagoula, Miss.	Nitrogen fertilizers	Exp. to 400 tons/day	$4.5-million, 100% expansion planned; includes doubling of ammonia capacity to 140,000 tons/yr.
Cooperative Farm Chemicals Assn.	Lawrence, Kan.	Nitric acid	120 tons/day	Construction contract awarded.
W. R. Grace & Co.	Big Spring, Tex.	Ammonia, urea	250 tons/day	Due on stream early 1962.
W. R. Grace & Co.	Ridgewood, Fla.	Phosphate rock		Expansion and modernization completed.
Hercules Powder Co.	Louisiana, Mo.	Ammonium nitrate solutions	50,000 tons/yr.	Due completed summer 1962.
		Ammoniated ammonium nitrate	40,000 tons/yr.	
International Minerals & Chemical Corp.	Bonnie, Fla.	Diammonium phosphate	Exp. to 100,000 tons/yr.	$3.8-million expansion due on stream October 31, 1961.
Mississippi Chemical Corp.	Yazoo City, Miss.	Urea		Plant completed.
Northwest Co-operative Mills, Inc.	Pine Bend, Minn.	Ammonium phosphate	100,000 tons/yr.	$4-million plant due on stream summer 1962. Product will be water-soluble.
The Seagrave Corp.	Phoenix, Ariz.	Organic compost	300 tons/day	Planned plant will use bacteriological method to convert garbage to compost.
J. R. Simplot Co.	Pocatello, Idaho	Phosphate fertilizers		80–100% expansion underway, involving transfer of equipment from another site.
Solar Nitrogen Chemicals, Inc.	Joplin, Mo.	Ammonia, urea, nitrogen solutions		Ammonia unit on stream; rest of plant under construction.

Fertilizers —*Continued*

Company	Location	Products	Capacity	Status and Remarks
Southern Nitrogen Co.	Savannah, Ga.	Ammonia, anhydrous	Exp. to 150,000 tons/yr.	$5-million project under way.
		Nitric acid	Exp. to 33,000 tons/yr.	
		Ammonium nitrate		
Spencer Chemical Co.	Pittsburg, Kan.	High-analysis fertilizers	Over 50,000 tons/yr.	Due on stream 1962, unit will produce product containing 30% N and 10% P.
Tennessee Corp.	Gibsonton, Fla.	Ammonia	100,000 tons/yr.	$11-million plant due completed 1962.
Tennessee Corp.	Gibsonton, Fla.	Phosphate products		50% expansion due completed by early 1962.
Tennessee Corp.	Tampa, Fla.	Diammonium phosphate	Exp. to 200,000 tons/yr.	100% expansion completed.
Tennessee Valley Authority	Muscle Shoals, Ala.	Phosphorus		$3-million, 25,000-kw. furnace due on stream early 1963, will replace several smaller furnaces.

Inorganics

Company	Location	Products	Capacity	Status and Remarks
Air Products & Chemicals, Inc.	Granite City, Ill.	Oxygen, liquid and gaseous	Over 170 tons/day	$6-million plant completed.
Air Products & Chemicals, Inc.	Sparrows Point, Md.	Nitrogen	450 tons/day	$6-million plant due completed third quarter 1961.
		Oxygen	350 tons/day	
Air Reduction Chemical & Carbide Co.	Louisville, Ky.	Lime	335 tons/day	$2.75-million kiln under construction will treat waste carbide lime feedstock. Due on stream early 1962.
Air Reduction Sales Co.	Baton Rouge, La.	Liquid oxygen, nitrogen, argon	30 tons/day	On stream.
Air Reduction Sales Co.	Claymont, Del.	Nitrogen	25 tons/day	$5-million plant under construction, described as first air separation facility to serve petrochemical industry.
		Oxygen	Over 350 tons/day	
Air Reduction Sales Co.	Johnstown, Pa.	Oxygen	675 tons/day	$5-million plant due completed late 1961.
Air Reduction Sales Co.	Tampa, Fla.	Liquid oxygen, nitrogen, argon	30 tons/day	On stream.
Allied Chemical Corp.	Brunswick, Ga.	Caustic, chlorine		Expansion due completed Aug. 1961.
Allied Chemical Corp.	Buffalo, N. Y.	Coke		Battery of 60 ovens due completed by end of 1961.
Allied Chemical Corp.	Hopewell, Va.	Nitrogen tetroxide		Due on stream Aug. 1961.
Allied Chemical Corp.	Moundsville, W. Va.	Caustic, chlorine		Expansion due on stream Oct. 1961.
Allied Chemical Corp.	North Claymont, Del.	Hydrofluoric acid		50% expansion completed.
American Cyanamid Co.	Fortier, La.	Anhydrous ammonia		40% expansion due completed late 1962.
American Potash & Chemical Corp., Laporte Industries Ltd.		Titanium dioxide	25,000 tons/yr.	Western site not yet selected for planned $15-million plant.
Arkansas Cement Corp.	Foreman, Ark.	Cement	Exp. to 2.8 MM bbl./yr.	$7.5-million, 100% expansion due completed first half 1962.
Arkansas Chemicals, Inc.	El Dorado, Ark.	Bromine	30 MM lb./yr.	On stream.
Associated Chemicals Co.	Pomona, Calif.	Alum (solid)		On stream.
Atlantic Cement Co.	Ravena, N. Y.	Cement	10 MM bbl./yr.	$64-million plant due on stream 1963.
Atlantic Refining Co.	Port Arthur, Tex.	Sulfur	35 tons/day	Construction contract awarded for $250,000 plant to treat hydrogen sulfide from adjacent refinery.
Beryllium Corp.; United Technical Industries, Inc.	Delta, Utah	Beryllium oxide	25,000–30,000 lb./mo.	$1-million plant essentially completed summer 1961, will produce concentrated, 97% product.
Beryllium Resources, Inc.	Delta, Utah	Beryllium oxide concentrate	2 tons/day	Planned $2.5-million plant will use Van Dornick flotation process.
Bunker Hill Co.	Kellogg, Idaho	Sulfuric acid	75,000 tons/yr.	Tentatively planned $5-million addition to lead smelter; includes sintering unit.
Cargill, Inc.	Belle Isle, La.	Rock Salt	400,000 tons/yr.	Mine and plant due on stream 1962.
Chemetron Corp.	Dallas, Tex.	Oxygen, nitrogen, argon	120 tons/day	$1-million plant planned.
Chemetron Corp.	Farrell, Pa.	Oxygen, nitrogen	370 tons/day	Due on stream 1962, will supply nearby steel plant.
Chemical Products Corp.	Cartersville, Ga.	Sodium silicates		Due on stream Oct. 1961.
Collier Carbon & Chemical Co.	Los Angeles, Calif.	Sulfuric acid	250 tons/day	On stream; converts spent alkylation acid, H_2S and sulfur.
Columbia-Southern Chemical Corp.	Corpus Christi, Tex.	Chrome chemicals		Plant completed.
Columbia-Southern Chemical Corp.	Lake Charles, La.	Sodium chlorate	15,000 tons/yr.	Due on stream Sept. 1962.
Columbian Carbon Co.	North Bend, La.	Carbon black		$2-million expansion planned.
Continental Carbon Co.	Bakersfield, Calif.	Carbon black	50 MM lb./yr.	Due on stream second half 1961.
Diamond Alkali Co.	Deer Park, Tex.	Ammonia	100 tons/day	Due on stream early 1962.
Dixon Chemical & Research, Inc.	Newark, N. J.	Sulfur dioxide, liquid	10,000 tons/yr.	$660,000 plant due completed March 1962.
Dixon Chemical & Research, Inc.	Paulsboro, N. J.	Hydrofluoric acid	10,000 metric tons/yr.	Due on stream summer 1961.
Dominion Tar & Chemical Co.	Tacoma, Wash.	Lime		$2-million plant due on stream early 1962.
Donner-Hanna Coke Corp.	Buffalo, N. Y.	Coke		Multimillion-dollar oven replacement program due completed late 1961 or early 1962.
Dow Corning Corp.	Hemlock, Mich.	High-purity silicon	25,000 lb./yr.	$2-million plant on stream.
E. I. du Pont de Nemours & Co.	Belle, W. Va.	Alumina, colloidal		Plant completed.
E. I. du Pont de Nemours & Co.	La Porte, Tex.	Sulfuric acid		Planned.
E. I. du Pont de Nemours & Co.	New Johnsonville, Tenn.	Titanium dioxide pigment	Exp. to 58,500 tons/yr.	30% expansion planned.
FMC Corp.	Modesto, Calif.	Barium hydroxide monohydrate		Due on stream late 1961.
FMC Corp.	South Charleston, W. Va.	Hydrogen peroxide		Multimillion-dollar unit due on stream late 1962.
FMC Corp.; U. S. Steel Corp.	Kemmerer, Wyo.	Coke	250 tons/day	$3.5-million demonstration plant, starting up, will utilize low-grade coal.
Ford Motor Co.	Nashville, Tenn.	Glass	Exp. to 1,100 tons/day	Expansion completed.
General Aniline & Film Corp.	Linden, N. J.	Chlorine, caustic	Exp. to 230 tons/day	360% expansion due completed early 1963.
General Dynamics Corp.	Tewksbury, Mass.	Liquid nitrogen, oxygen, argon		Due on stream by Jan. 1, 1962.
W. R. Grace & Co.	Memphis, Tenn.	Ammonia	Exp. to 160,000 tons/yr.	60% expansion completed.

Inorganics—*Continued*

Company	Location	Products	Capacity	Status and Remarks
Harshaw Chemical Co.	Elyria, Ohio	Zirconium oxide		Expansion completed.
Hooker Chemical Corp.	Columbia, Tenn.	Phosphorus		$6.4-million expansion due completed early 1962.
Hooker Chemical Corp.	Columbus, Miss.	Sodium chlorate		Due completed late 1961.
Hooker Chemical Corp.	Niagara Falls, N. Y.	Chlorine, caustic soda		Expansion completed.
Houston Chemical Corp.	Beaumont, Tex.	Nitrogen, high purity		Completed.
Huron Portland Cement Co.	Alpena, Mich.	Cement		Installing large new kiln.
Hydrocarbon Research, Inc.	Pasadena, Tex.	Oxygen	730 tons/day	Planned $6.5-million plant will supply Tenneco Chemical petrochemical group.
		Nitrogen		
International Glass Industries	Tacoma, Wash.	Flat glass	20 tons/day	Planned plant will cost about $800,000.
Kaiser Aluminum & Chemical Corp.	Baton Rouge, La.	Tabular alumina, active alumina		Active-alumina unit completed; tabular-alumina unit due on stream late 1961.
Linde Co.	Cincinnati, Ohio	Oxygen	25 tons/day	On stream; output goes to making ozone.
Linde Co.	Deer Park, Tex.	Oxygen, nitrogen		Planned.
Linde Co.	Ecorse, Mich.	Oxygen	Exp. to 850 tons/day	New unit, due completed mid-1962, will increase capacity 70%
Linde Co.	Fontana, Calif.	Liquid hydrogen	21 tons/day	Due on stream June 1962.
Linde Co.	Houston, Tex.	Oxygen	460 tons/day	Due on stream Feb. 1962.
Linde Co.	Huntsville, Ala.	Liquid oxygen, liquid nitrogen	140 tons/day	On stream, uses low-pressure (150 psi.) liquefaction cycle.
Linde Co.	Institute, W. Va.	Oxygen, nitrogen	300 tons/day	Due on stream Oct. 1961.
Linde Co.	Middleton, Ohio	Oxygen	140 tons/day	Second on-site plant on stream, raises Armco's oxygen supply to 270 tons/day.
Linde Co.	Midland, Pa.	Oxygen	200 tons/day	Due on stream Dec. 1961.
Linde Co.	Neosho, Mo.	Liquid oxygen, nitrogen	140 tons/day	On stream.
Linde Co.	Pueblo, Colo.	Oxygen	280 tons/day	On stream.
Linde Co.	Youngstown, Ohio	Oxygen	280 tons/day	Due on stream early 1962, will supply 99.5% oxygen to Youngstown Sheet & Tube Co.
Marquette Cement Co.	Catskill, N. Y.	Cement clinker	Exp. to 2.5 MM bbl./yr.	50% expansion planned.
Metal Carbides, Inc.	Murfreesboro, Tenn.	Tungsten carbide		Due on stream Nov. 1961.
Metal Hydrides, Inc.	Danvers, Mass.	Sodium borohydride	Over 2 MM lb./yr.	Due completed fall 1961.
Monochem, Inc.	Geismar, La.	Oxygen	600 tons/day	$2-million plant planned.
Monsanto Chemical Co.	Addyston, Ohio	Concentrated phosphoric acid		On stream; product equivalent to 105% orthophosphoric acid.
Morton Chemical Co.	Geismar, La.	Hydrogen chloride, anhydrous		Due completed early 1962.
Olin Mathieson Chemical Corp.	Joliet, Ill.	Phosphoric acid		$1.5-million plant completed.
Olin Mathieson Chemical Corp.	Saltville, Va.	Hydrazine		$15-million plant on stream.
Pearsall Chemical Corp.	La Porte, Tex.	Aluminum chloride		Plant completed.
Penn-Olin Chemical Co.	Calvert City, Ky.	Sodium chlorate		$6.5-million plant under construction.
Pennsylvania Glass & Sand Corp.	Columbia, S. C.	Silica		$1-million purification plant due completed late 1961.
Potash Co. of America	Carlsbad, N. M.	Potash		$3.5-million modernization due completed mid-1962.
Shamrock Oil & Gas Corp.	Amarillo, Tex.	Ammonia	150 tons/day	Due on stream early 1962.
Shamrock Oil & Gas Corp.	Sunray, Tex.	Ammonia	150 tons/day	Due completed early 1962.
Southern Cement Co.	Atlanta, Ga.	Portland cement	1.5 MM bbl./yr	Due completed early 1963.
Stauffer Chemical Co.	Baton Rouge, La.	Sulfur dioxide	10,000 tons/yr.	Plant on stream, uses reaction between sulfur and sulfur trioxide.
Stauffer Chemical Co.	Dominguez, Calif.	Chlorine, caustic soda		Multimillion-dollar plant due completed by third quarter 1962.
Stauffer Chemical Co.	Green River, Wyo.	Sodium sesquicarbonate		Under construction.
Stauffer Chemical Co.; U. S. Smelting Refining & Mining Co.	Salt Lake City, Utah	Coke		Due completed fourth quarter 1961; will treat low-grade bituminous coal.
Susquehanna-Western, Inc.	Falls City, Tex.	Uranium concentrates	250 tons/day	$2-million mill on stream.
Tenneco Chemical Co.	Houston, Tex.	Oxygen, nitrogen		Planned unit will feed chemicals complex that will be at same site.
Texaco Inc.	Lockport, Ill.	Ammonia	Exp. to 220 tons/day	22% expansion completed.
Texas Gulf Sulfur Co.	Moab, Utah	Muriate of potash	1.1 MM tons/yr.	$30-million mining and processing complex due on stream late 1962.
Texas Jersey Mfg. Co.	La Porte, Tex.	Aluminum chloride	Over 5 MM lb./yr.	On stream.
United Carbon Co.	Mojave, Calif.	Carbon black	64 MM lb./yr.	$5-million plant due on stream late 1961 or early 1962.
U. S. Borax & Chemical Co.	Boron, Calif.	Borax products		Expansion under way.
Virginia-Carolina Chemical Corp.	Nichols, Fla.	Phosphate rock, calcined	Exp. by 400,000 tons/yr.	New rotary kiln installed.
West End Chemical Co.	Westend, Calif.	Sodium sulfate	Exp. to 200,000 tons/yr.	Expansion completed.

Metals

Company	Location	Products	Capacity	Status and Remarks
Allegheny Ludlum Steel Corp.	Albany, N. Y.	High-alloy steels		New vacuum smelting furnace on stream, described as world's largest.
Aluminum Co. of America	Badin, N. C.	Primary aluminum		Modernization under way.
American Potash & Chemical Corp.	Aberdeen, Miss.	Manganese	10 MM lb./yr.	$5-million facility due completed first quarter 1962.
Beryllium Corp.	Hazleton, Pa.	Beryllium	Exp. to 25,000 lb./mo.	Expansion completed.
Beryllium Metals & Chemicals	Bessemer City, N. C.	Beryllium, beryllium chemicals		Due on stream by late summer 1962.
Brush Beryllium Co.	Elmore, Ohio	Beryllium		$6-million expansion completed, increasing company capacity from 12,000 to over 30,000 lb./mo.
Colorado Fuel & Iron Corp.	Pueblo, Colo.	Steel		$21-million expansion under way.
E. I. du Pont de Nemours & Co.	Baltimore, Md.	Columbium, titanium, molybdenum, tantalum		$12-million plant on stream

Metals—*Continued*

Company	Location	Products	Capacity	Status and Remarks
Kaiser Aluminum & Chemical Corp.	Mead, Wash.	Aluminum	Exp. to 2,650 tons/yr.	55% expansion completed; plant makes 99.99+% pure aluminum.
Kawecki Chemical Co.	Boyertown, Pa.	Columbium, columbium alloys		Due on stream 1961.
Kennecott Copper Co.	Garfield, Utah	Copper		Current smelter renovations will cost over $5-million.
Metal & Thermit Corp.	Portland, Ore.	Tin		Detinning plant planned.
Metal & Thermit Corp.	Tampa, Fla.	Tin		$500,000 plant on stream, recovers tin scrap.
The New Jersey Zinc Co.	Palmerton, Pa.	Spiegeleisen alloy		Multimillion-dollar electric furnace project due completed 1962.
Reynolds Metals Co.	Sheffield, Ala.	Aluminum alloys		$2.5-million expansion under way for cast house, involving new holding and melting furnaces.
Roanoke Electric Steel Corp.	Roanoke, Va.	Steel		Continuous casting plant planned; will use Babcock & Wilcox Co. process based on pouring steel from a 75-ft. tower.
Sharon Steel Corp.	Farrell, Pa.	Steel	1 MM tons/yr.	Planned $17.5-million plant will use basic oxygen steelmaking process.
Stauffer Chemical Co.	Richmond, Calif.	Refined refractory metals	30,000 lb./mo.	New electron-beam furnace installed, described as world's largest.
Temescal Metallurgical Corp.	Berkeley, Calif.	Refractory and other metals		25-ton electron-beam furnace being installed; will permit plant to add tungsten, zirconium, other metals to its line.

Organics

Company	Location	Products	Capacity	Status and Remarks
Air Products & Chemicals, Inc.; Tidewater Oil Co.	Delaware City, Del.	Oxo alcohols	60 MM lb./yr.	Planned.
Alcon Laboratories	Fort Worth, Tex.	Pharmaceuticals		New facilities completed, over $2 million.
Allied Chemical Corp.	Buffalo, N. Y.	Succinic anhydride		New plant on stream, doubles company's succinic anhydride capacity.
Allied Chemical Corp.	California	Toluene diisocyanate	15 MM lb./yr.	Due completed 1962.
Allied Chemical Corp.	Elizabeth, N. J.	Fluorinated hydrocarbons	Over 10,000 tons/yr.	On stream.
Allied Chemical Corp.	Hopewell, Va.	Caprolactam		Nearly completed.
Allied Chemical Corp.	Moundsville, W. Va.	Diisocyanates	Exp. to 25 MM lb./yr.	Expansion, tripling capacity, due completed mid-1962.
Allied Chemical Corp.	South Point, Ohio	Melamine crystals	20 MM lb./yr.	Due on stream early 1962; first commercial unit to use urea for feed.
Allied Chemical Corp.	South Point, Ohio	Methanol	Exp. to 24 MM gal./yr.	50% expansion completed.
Allied Chemical Corp.	Southern California	Isocyanates	15 MM lb./yr.	Planned unit will be first isocyanate plant on West Coast.
American Viscose Corp.	Marcus Hook, Pa.	Microcrystalline cellulose	1 MM lb./yr.	On stream.
Amoco Chemicals Corp.	Joliet, Ill.	Dimethyl terephthalate		Expansion under way.
Amoco Chemicals Corp.	Joliet, Ill.	Trimellitic anhydride		Multimillion-lb./yr. unit due on stream fourth quarter 1961.
Ansul Chemical Co.; Continental Oil Co.	Lake Charles, La.	Methyl chloride	60 MM lb./yr.	Due completed early 1962, will cost over $1 million
Ashland Oil & Refining Co.	Ashland, Ky.	Benzene, toluene, xylenes		Udex unit completed.
Ashland Oil & Refining Co.	Catlettsburg, Ky.	Naphthalene Benzene	75–100 MM lb./yr. 6 MM gal./yr.	Hydrodealkylation plant on stream.
Atlantic Refining Co.; Pure Oil Co.	Nederland, Tex.	Benzene, toluene, xylenes	50 MM gal./yr.	Udex aromatics-extraction unit due completed Dec. 1961.
Atlas Chemical Industries, Inc.	New Castle, Del.	Glycerin, other polyols	50 MM lb./yr.	$17-million plant, due completed second quarter 1962, will operate on molasses feed.
Aurora Gasoline Co.	Detroit, Mich.	Benzene-toluene stock		Planned catalytic reformer and extraction units will help firm fulfill benzene-toluene supply contract with Dow Chemical Co. Due on stream mid-1962.
Baird Chemical Industries	Illinois	Sorbitol	20 MM lb./yr.	Planned.
Bethelehem Steel Co.	Sparrows Point, Md.	Naphthalene Coke-oven-tar acids	42 MM lb./yr.	Distillation unit for coke-oven tar will process over 50 MM gal./yr., is due on stream late 1961.
Borden Chemical Co.	Geismar, La.	Methanol Vinyl acetate	25 MM gal./yr. 50 MM lb./yr.	Methanol unit due on stream by May 1962; acetate unit due in operation later in 1962. Total investment: $15 million.
Borden Chemical Co.; U. S. Rubber Co.	Baton Rouge, La.	Acetylene	80 MM lb./yr	Construction contract awarded.
Bzura Chemical Co.	Fieldsboro, N. J.	Citric acid	16 MM lb./yr.	On stream.
California Chemical Co.	Richmond, Calif.	Maleic anhydride	20 MM lb./yr.	On stream.
California Corp. for Biochemical Research	Los Angeles, Calif.	Fine biochemicals		$1-million expansion planned.
Celanese Corp. of America	Bay City, Tex.	Acetaldehyde 2-Ethyl hexanol	100 MM lb./yr.	$12-million plant due completed by mid-1962, will use Aldehyd GmbH. process.
Celanese Corp. of America	Pampa, Tex.	Acrylate esters, acrylic acid	14 MM lb./yr.	Completed units bring company's total acrylate capacity at Pampa to 30 MM lb./yr.
Collier Carbon & Chemical Co.; Tidewater Oil Co.	Delaware City, Del.	Naphthalene	100 MM lb./yr.	Due on stream Nov. 1961.
Collier Carbon & Chemical Co.; Tidewater Oil Co.	Los Angeles, Calif.	Naphthalene		Construction due to start 1961.
Columbia Southern Chemical Corp.	Lake Charles, La.	Ethylene dichloride	100 MM lb./yr.	Plant completed.
Continental Oil Co.	Lake Charles, La.	Industrial alcohols		$734,000 expansion due completed late 1961.
Continental Oil Co.	Ponca City, Okla.	Cyclohexane	Over 20 MM gal./yr.	$1-million plant on stream.
Cosden Petroleum Corp.	Big Spring, Tex.	Ethylbenzene		New UOP Alkar unit, described as first in the world, meets refinery's expanded ethylbenzene needs for styrene production.

Organics—*Continued*

Company	Location	Products	Capacity	Status and Remarks
Cosden Petroleum Corp.	Big Spring, Tex.	Styrene	Exp. to over 60 MM lb./yr.	Capacity has been tripled.
Crown Central Petroleum Corp.	Houston, Tex.	Benzene	4 MM gal./yr.	Udex aromatics-extraction unit due on stream Oct. 1961. Capacities unconfirmed.
		Toluene	10 MM gal./yr.	
		Xylenes	12 MM gal./yr.	
Crown Central Petroleum Corp.	Pasadena, Tex.	Benzene	17 MM gal./yr.	On stream; uses Detol hydrodealkylation.
Diamond Alkali Co.	Deer Park, Tex.	Acetylene	40 MM lb./yr.	Due on stream Jan. 1962. Capacity of vinyl chloride unit unconfirmed.
		Vinyl chloride	90 MM lb./yr.	
Dow Badische Chemical Co.	Freeport, Tex.	C_4 oxo chemicals	25 MM lb./yr.	On stream.
Dow Badische Chemical Co.	Freeport, Tex.	Caprolactam	40 MM lb./yr.	Due completed early 1962.
Dow Chemical Co.	Bay City, Mich.	Benzene		Planned unit will use undisclosed process to convert benzene-toluene mixture to benzene.
Dow Chemical Co.	Freeport, Tex.	Benzene	30 MM gal./yr.	Plant completed, uses undisclosed process to treat hydrocarbon feed.
Dow Chemical Co.	Freeport, Tex.	Propylene carbonate		On stream.
Dow Chemical Co.	Kalama, Wash.	Phenol	36 MM lb./yr.	Due completed late 1961.
Dow Chemical Co.	Pittsburg, Calif.	Phenolsulfonic acid		On stream.
Dow Chemical Co.	Plaquemine, La.	Methyl cellulose		$3.5-million plant completed.
E. I. du Pont de Nemours & Co.	Beaumont, Tex.	Acrylonitrile	50 MM lb./yr.	Due on stream early 1962; capacity unconfirmed.
E. I. du Pont de Nemours & Co.	Beaumont, Tex.	Caprolactam	50 MM lb./yr.	On stream.
E. I. du Pont de Nemours & Co.	Belle, W. Va.	Methylamines	20 MM lb./yr.	On stream; capacity unconfirmed.
E. I. du Pont de Nemours & Co.	Huron, Ohio	Methanol	30 MM gal./yr.	Due on stream late 1962 or early 1963.
E. I. du Pont de Nemours & Co.	Louisville, Ky.	Vinyl fluoride chemicals		$3-million plant planned.
E. I. du Pont de Nemours & Co.	Montague, Mich.	Acetylene	50 MM lb./yr.	Due completed early 1963; will crack hydrocarbons with an electric arc.
E. I. du Pont de Nemours & Co.	Orange, Tex.	Methanol	Exp. by 30 MM gal./yr.	Expansion due completed by Dec. 1961.
DX Sunray Oil Co.	Tulsa, Okla.	Benzene	1,000 bbl./day	Hydeal hydrodealkylation unit on stream.
El Paso Natural Gas Co.	Odessa, Tex.	Benzene	900 bbl./day	Due completed 1961.
El Paso Natural Gas Co.	Odessa, Tex.	Styrene		Expansion planned.
El Paso Natural Gas Co; Rexall Chemical Co.	Odessa, Tex.	Petrochemicals		$80-million complex, due completed in 1965, will make ethylene, propylene, polyethylene, polypropylene. 120-MM-lb./yr. polyethylene unit due on stream early 1962, supplied by 180-MM-lb./yr. olefins plant to be operated by El Paso Natural Gas.
Emery Industries, Inc.	Cincinnati, Ohio	Oleic-acid-oxidation products		On stream; products include azelaic and and pelargonic acids.
Escambia Chemical Corp.	Pensacola, Fla.	Methanol	Exp. to 22 MM gal./yr.	Planned project also includes an increase in ammonia capacity from 200 to 230 tons/day.
		Urea solutions	50 tons/day	
Ethyl Corp.	Baton Rouge, La.	Methyl chloride	25 MM lb./yr.	On stream.
Ethyl Corp.	Orangeburg, S. C.	Orthoalkylated antioxidants		Expansion completed, doubling firm's capacity.
FMC Corp.	Baltimore, Md.	Dimethylhydrazine, unsymmetrical		Expansion completed.
FMC Corp.	Dothan, Ala.	Pesticides		On stream.
FMC Corp.	South Haven, Mich.	Pesticides		On stream.
Foote Mineral Co.	New Johnsonville, Tenn.	Butyl lithium	100,000 lb./yr.	On stream.
Foremost Food & Chemical Co.	Oakland, Calif.	Fatty nitrogen chemicals	20 MM lb./yr.	Plant completed.
Gulf Oil Corp.	Philadelphia, Pa.	Benzene	12 MM gal./yr.	Due on stream early 1962, will feed forthcoming cumene unit.
Gulf Oil Corp.	Philadelphia, Pa.	Cumene	90 MM lb./yr.	Due completed early 1962.
Gulf Oil Corp.	Philadelphia, Pa.	Oxo alcohols	36 MM lb./yr.	On stream.
Gulf Oil Corp.	Port Arthur, Tex.	Ethylene		Modifications completed.
Hercules Powder Co.	Hercules, Calif.	Methanol	8 MM gal./yr.	On stream.
		Formaldehyde	50 MM lb./yr.	
		Urea-formaldehyde compositions	11,000 tons/yr.	
Hercules Powder Co.	Hopewell, Va.	Hydroxyethylcellulose		Multimillion-lb./yr. unit due completed early 1962.
Heyden Newport Chemical Corp.	Fords, N. J.	Maleic anhydride	24 MM lb./yr.	On stream.
Heyden Newport Chemical Corp.	Garfield, N. J.	Fumaric acid	8 MM lb./yr.	On stream.
Hooker Chemical Corp.	South Shore, Ky.	Phenol		Due completed 1962.
Houston Chemical Corp.	Beaumont, Tex.	Ethylene oxide	80 MM lb./yr.	Due on stream late 1961.
Houston Chemical Corp.	Beaumont, Tex.	Tetraethyl and tetramethyl lead	60 MM lb./yr.	Multimillion-dollar plant due on stream summer 1961.
Humble Oil & Refining Co.	Baton Rouge, La.	Oxo alcohols	Exp. to 120 MM lb./yr.	33% expansion due completed early 1962
Humble Oil & Refining Co.	Baytown, Tex.	Benzene	Exp. to 55 MM gal./yr.	Hydrodealkylation unit under construction will increase capacity 85%.
Humble Oil & Refining Co.	Baytown, Tex.	Toluene	Exp. to 55 MM gal./yr.	Expansion will increase capacity 70%.
Humble Oil & Refining Co.	Baytown, Tex.	p-Xylene	Exp. to 105 MM lb./yr.	60% expansion due completed by April 1962.
Humble Oil & Refining Co.	Bayway, N. J.	Ethylene	Exp. to 175 MM lb./yr.	35% expansion of ethylene capacity due completed second quarter 1962.
Industrial Biochemicals, Inc.	Edison, N. J.	Gluconic acid derivatives	4.5 MM lb./yr.	Fermentation plant on stream.
Jefferson Chemical Co.	Conroe, Tex.	Polypropylene glycols		On stream.
Kolker Chemical Corp.	Newark, N. J.	Methyl chloride	Exp. to 7.5 MM lb./yr.	50% expansion due completed fall 1961.
Linde Co.	Pueblo, Colo.	Acetylene	1.5 MM cu.ft./mo.	On stream.
Merck & Co.	Elkton, Va.	Coccidiostat (antibiotic)		$2-million, 50% expansion nearly completed; will be followed by a $2-million, 40% expansion due finished by Feb. 1962. Product is used to treat poultry.
Miles Chemical Co.	Elkhart, Ind.	Citric acid	Exp. to 20 MM lb./yr.	Expansion completed.

Organics—*Continued*

Company	Location	Products	Capacity	Status and Remarks
Mobay Chemical Co.	New Martinsville, W. Va.	Isocyanate materials		Due on stream early 1962, plant will produce intermediates for drugs, pesticides and other materials.
Mobay Chemical Co.	New Martinsville, W. Va.	Toluene diisocyanate	Exp. to 50 MM lb./yr.	A completed expansion has raised capacity from 25 MM to 40 MM lb./yr. Additional $1.5-million, 10-MM-lb./yr. expansion under way.
Mobil Chemical Co.	Beaumont, Tex.	Benzene	30 MM gal./yr.	Due completed late 1961.
Mobil Chemical Co.	Beaumont, Tex.	Ethylene	380 MM lb./yr.	On stream.
Monochem, Inc.	Geismar, La.	Acetylene	80 MM lb./yr.	$20-million plant due on stream May 1962.
		Vinyl chloride	150 MM lb./yr.	
Monsanto Chemical Co.	Alvin, Tex.	Naphthalene	50 MM lb./yr.	Planned.
Monsanto Chemical Co.	Alvin, Tex.	Ethylene	500 MM lb./yr.	Planned.
Monsanto Chemical Co.	Anniston, Ala.	Parathion, methyl parathion.	Exp. to 18 MM lb./yr.	50% expansion of insecticides plant completed.
Monsanto Chemical Co.	Avon, Calif.	Phenosulfonic acid		On stream.
Monsanto Chemical Co.	Chocolate Bayou, Tex.	Ethylene	500 MM lb./yr.	Due on stream 1962, will supply hydrocarbon raw materials for other Monsanto operations.
		Benzene	42 MM gal./yr.	
		Naphthalene	50 MM lb./yr.	
		Other organics		
Monsanto Chemical Co.	Gloucester County, N. J.	Phthalic anhydride		Will use fluid-bed process.
Monsanto Chemical Co.	Kearny, N. J.	Alkyl phenols		On stream.
Monsanto Chemical Co.	Monsanto, Ill.	Herbicide esters		On stream.
Monsanto Chemical Co.	St. Louis, Mo.	Blended organic liquids		Centralized blending and packaging plant on stream; handles plasticizers, resin intermediates, petroleum additives and other liquids. Cost: over $1 million.
Monsanto Chemical Co.	Texas City, Tex.	Vinyl chloride monomer	Exp. to 150 MM lb./yr.	50% expansion completed.
Nalco Chemical Co.	Freeport, Tex.	Alkyl lead		Planned unit will make 40 MM lb./yr. tetraethyl lead or 34 MM lb./yr. tetramethyl lead.
National Starch & Chemical Co.	Texas	Vinyl acetate monomer	45 MM lb./yr.	$4-million plant due on stream fall 1962.
Nopco Chemical Co.	Linden, N. J.	Toluene diisocyanate, other isocyanates	10 MM lb./yr.	$7-million plant due on stream by early 1962.
Northern Gas Products Co.	Bushton, Kan.	Natural-gas hydrocarbons	896 MM SCFD input	$10-million extraction-plant project due completed Aug. 1961.
Northo Chemical Co.	Painesville, Ohio	Derivatives of fats and oils		New plant makes hydrogenated oils, fatty acids and esters, and other chemicals.
Olin Mathieson Chemical Corp.	Doe Run, Ky.	Ethylene oxide		Plant completed.
Olin Mathieson Chemical Corp.	Doe Run, Ky.	Glycerin	30–35 MM lb./yr.	Due on stream by end of 1961; capacity unconfirmed.
Olin Mathieson Chemical Corp.	Doe Run, Ky.	Propylene glycol, glycol ether		Expansion underway; includes ethylene fractionation unit.
Oxo Chemicals Co.	Haverhill, Ohio	Isooctyl and decyl alcohols	36 MM lb./yr.	Due on stream early 1962; capacity unconfirmed.
Pacific Laboratories	Honolulu, Hawaii	Hydrolytic enzymes		$400,000 plant on stream.
Pennsalt Chemicals Corp.	Wyandotte, Mich.	Alkyl amines		$2-million expansion, due completed early next year, will almost double capacity.
Petro-Tex Chemical Corp.	Houston, Tex.	Maleic anhydride	30 MM lb./yr.	Due on stream by end of 1961.
Petro-Tex Chemical Corp.	Houston, Tex.	Tetrahydrophthalic anhydride		Due on stream late 1961.
Phillips Petroleum Co.	Borger, Tex.	Isobutane	4,500 bbl./day	Isomerization unit on stream, uses UOP Butamer process.
Phillips Petroleum Co.	Sweeny, Tex.	Benzene	22 MM gal./yr.	Planned.
Pitt-Consol Chemical Co.	Newark, N. J.	Phenolic and mercaptan derivatives		Due on stream fall 1961.
Pittsburgh Chemical Co.	Neville Island, Pa.	Maleic anhydride	20 MM lb./yr.	On stream.
Plymouth Oil Co.	Texas City, Tex.	Benzene	5 MM gal./yr.	$2.5-million Udex extraction unit due on stream summer 1961.
Pure Oil Co.	Lemont, Ill.	Benzene, toluene, xylenes	26 MM gal./yr.	Due completed Nov. 1961.
Quaker Oats Co.	Memphis, Tenn.	Furfural derivatives		Expansion planned.
Reichhold Chemicals, Inc.	Elizabeth, N. J.	Maleic anhydride	20 MM lb./yr.	$4-million plant on stream.
Reichhold Chemicals, Inc.	Houston, Tex.	Vinyl acetate monomer	50 MM lb./yr.	$10-million plant planned.
Rohm & Haas Co.	Louisville, Ky.	Adipic acid	20 MM lb./yr.	Due completed summer 1962; capacity unconfirmed.
Schenectady Varnish Co.	Rotterdam Junction, N. Y.	Phenol	20–25 MM lb./yr.	Due on stream early 1962, will utilize direct oxidation of benzene. Capacity unconfirmed.
Shell Chemical Co.	Norco, La.	Glycerin		On stream, uses Shell-developed process.
Shell Chemical Co.	Sheridan, Tex.	Ethane		Under construction; will process ethane-rich streams from refineries at Sheridan and Provident City, Tex.
Shell Chemical Co.	Torrance, Calif.	Styrene	Exp. to 17.5 MM lb./mo.	17% expansion completed.
Shell Oil Co.	Wilmington, Calif.; Houston, Tex.; Wood River, Ill.	Benzene	Exp. to over 60 MM gal./yr. total	Expansion program for three refineries completed.
Sinclair Refining Co.	Houston, Tex.	o-Xylene		On stream.
Sinclair-Koppers Chemical Co.	Houston, Tex.	Styrene	70 MM lb./yr.	Due on stream summer 1961.
Stauffer Chemical Co.	Weston, Mich.	Trialkyl phosphates		On stream.
Stepan Chemical Co.		Tetraethyl and tetramethyl lead		Planned facility will use an Italian process. Location and capacity not revealed.
Sun Oil Co.	Toledo, Ohio	Naphthalene, benzene	100 MM lb./yr.	Hydrodealkylation plant will use company-developed process, is due on stream late 1961.
SunOlin Chemical Co.	Claymont, Del.	Ethylene	105 MM lb./yr.	Over $20-million plant due completed late 1961, will obtain ethylene by direct distillation. Plant designed for easy expansion to 225 MM lb./yr. ethylene.
		Ethylene oxide	55 MM lb./yr.	
Sunray Mid-Continent Oil Co.	Corpus Christi, Tex.	Styrene monomer	60 MM lb./yr.	Under construction.

Organics—*Continued*

Company	Location	Products	Capacity	Status and Remarks
Sunray Mid-Continent Oil Co.	Tulsa, Okla.	Benzene, naphthalene		Planned hydrodealkylation plant.
Sunray Mid-Continent Oil Co.	Tulsa, Okla.	Styrene monomer	60 MM lb./yr.	Due completed spring 1962.
Suntide Refining Co.	Corpus Christi, Tex.	Benzene	Exp. to 1,200 bbl./day	New $850,000 hydrodealkylation unit has almost tripled plant benzene capacity.
Suntide Refining Co.	Corpus Christi, Tex.	Ethyl benzene	330 bbl./day	Separation unit, on stream.
Suntide Refining Co.	Corpus Christi, Tex.	Styrene	60 MM lb./yr.	Due on stream 1962.
Suntide Refining Co.	Corpus Christi, Tex.	p-Xylene	15 MM lb./yr.	Due completed Jan. 1962.
Swift & Co.	Hammond, Ind.	Epoxidized oils, fatty esters	Exp. by 8 MM lb./yr.	On stream.
Tenneco Chemical Co.	Houston, Tex.	Acetylene	100 MM lb./yr.	Multimillion-dollar plant due completed 1962.
		Vinyl chloride monomer	200 MM lb./yr.	
		Vinyl acetate monomer, ammonia, methanol		
Tenneco Chemical Co.	Houston, Tex.	Methanol	25 MM gal./yr.	Planned; capacity unconfirmed.
Tenneco Oil Co.	Chalmette, La.	Aromatics	6,000 bbl./day input	Catalytic reforming unit on stream, products include benzene, toluene, xylenes, ethylbenzene and heavy aromatic solvents.
Texaco Inc.	Port Arthur, Tex.	Benzene	30 MM gal./yr.	Planned.
Texas Gas Corp.	Winnie, Tex.	Benzene concentrate	500 bbl./day	Plant modernization has added concentrated benzene to refinery product slate.
Ultra Chemical Works	Chicago, Ill.	Synthetic detergents	15,000 tons/yr.	$1.6-million plant on stream; initial product is dodecyl benzene sulfonate.
Union Carbide Chemicals Co.	Institute, W. Va.	Phthalic anhydride	50 MM lb./yr.	Fluid-bed plant, due on stream late 1962.
Union Carbide Chemicals Co.	South Charleston, W. Va.	Alkylamines		On stream.
Union Carbide Chemicals Co.	Texas City, Tex.	Ethylene amines		Expansion under way.
U. S. Industrial Chemicals Co.	Tuscola, Ill.	Ethyl ether		New refining unit on stream.
U. S. Peroxygen Corp.	Richmond, Calif.	Benzoyl peroxide pastes		Expansion completed, tripling output.
U. S. Steel Corp.	Clairton, Pa.	Coal-tar-distillation products		On stream.
Wasco Laboratories	Vernon, N. J.	Synthetic waxes, emulsion polymers, other specialties		Work under way to convert former creamery.
Witco Chemical Co.	Chicago, Ill.	Polyethers		$500,000 plant on stream.
Witco Chemical Co.	Perth Amboy, N. J.	Phthalic anhydride	30 MM lb./yr.	Due on stream fourth quarter 1961.
Witfield Chemical Corp.	Los Angeles, Calif.	Alkyl benzene	30 MM lb./yr.	Due on stream fourth quarter 1961.
Wyandotte Chemicals Corp.	Wyandotte, Mich.	Propylene oxide		$3.5-million plant due on stream by mid-1962

Petroleum and Natural Gas Products

Company	Location	Products	Capacity	Status and Remarks
American Gilsonite Co.	Grand Junction, Colo.	Propane, butane	325 bbl./day	Planned $300,000 unit will extract products from gilsonite.
American Oil Co.	Casper, Wyo.	Refinery intermediates	37,000 bbl./day input	Crude distillation unit, due completed fall 1961.
American Oil Co.	Sugar Creek, Mo.	Refinery intermediates	70,000 bbl./day input	New crude-distillation unit due on stream July 1, 1962.
American Oil Co.	Texas City, Tex.	Petroleum products		Refinery expansion under way.
American Oil Co.	Whiting, Ind.	Alkylate	12,000 bbl./day	Alkylation unit on stream.
American Oil Co.	Whiting, Ind.	Refinery intermediates	Exp. to 45,000 bbl./day feed	Modification of catalytic cracker completed upping unit's feed rate by 13%.
Apco Oil Corp.	Arkansas City, Kan.	Light gasoline, naphtha	2,950 bbl./day input	UOP Lomax hydrocracking unit planned.
Arkansas Fuel Oil Corp., Shell Oil Co.	Starr County, Tex.	Natural gas products	35 MM cu.ft./day input	Under construction; will yield about 13,500 gal. propane, 14,000 gal. LPG and 7,900 gal. gasoline daily.
Ashland Oil & Refining Co.	Ashland, Ky.	Asphalt, gas oil, cylinder stock	32,000 bbl./day input	New vacuum unit on stream.
Atlantic Refining Co.	George West, Tex.	Propane	32,000 gal./day	$1.5-million plant due on stream late 1961, will process 60 MM cu.ft./day gas.
		Butane	17,500 gal./day	
		Gasoline	7,600 gal./day	
Atlantic Refining Co.	Hebbronville, Tex.	Natural gas products	100 MM SCFD input	Under construction.
California Oil Co.	Uintah County, Utah.	Natural gasoline	26 MM SCFD input	On stream.
Champlin Oil Co.	Enid, Okla.	Petroleum products		Planned $3-million expansion will include a delayed-coker unit.
Chemoil Corp.	Gramercy, La.	Petroleum products	40,000 bbl./day crude feed	$60-million refinery planned.
Continental Oil Co.	Lake Charles, La.	Natural gas products	Exp. to 150 MM SCFD input	$2-million, 50% expansion completed.
Continental Oil Co.	Medford, Okla.	Natural gas products	30 MMSCFD input input	$930,000 plant on stream.
Continental Oil Co.	South Louisiana	Natural gas products	175 MM cu.ft./day	On stream.
Continental Oil Co., others	Hennessey, Okla.	Natural gas products	30 MM SCFD input	$1.75-million plant due completed fall 1961.
Crown Central Petroleum Corp.	Houston, Tex.	Catalytic reformate		Catalytic reformer undergoing 50% exp.
Delta Refining Co.	Memphis, Tenn.	Refinery intermediates	Exp. to 22,000 bbl./day input	Catalytic cracking capacity now being doubled.
DX Sunray Oil Co.	Tulsa, Okla.	Refinery intermediates	85,000 bbl./day input	Multimillion-dollar crude distillation unit under construction.
Florida Hydrocarbons Co.	Brooker, Fla.	Natural gas products		$7-million extraction plant planned.
Florida Southern Oil Co.	Jacksonville, Fla.	Refinery products		New oil refinery due completed within 2½ years.
Frio-Tex Oil & Gas Co.	Corpus Christi, Tex.	Natural gas products	20 MM SCFD input	Planned.
Golden Eagle Refining Co.	Los Angeles, Calif.	Gasoline	Exp. to 30,000 bbl./day input	Planned 230% expansion will probably involve UOP's Lomax process.
Goliad Corp.	Sheridan, Tex.	Natural gas products	Exp. to 225 MM cu.ft./day input	Expansion, costing over $1 million, due on stream Oct. 1961.
Goliad Corp., Union Oil Co. of California	Cow Island, La.	Natural gas liquids	Exp. input to 600 MM cu.ft./day	20% expansion planned.
Gulf Oil Corp.	Port Arthur, Tex.	Coke	12,000 bbl./day input	Coker completed.
Gulf Oil Corp.	Port Arthur, Tex.	Processed lube oils	13,000 bbl./day	Plant completed.
Helium Conservation Corp.	White Deer, Tex.	Helium	50 MM cu.ft./day input	$3-million extraction plant planned; will treat natural gas.
Hondo Oil & Gas Co., Pan American Petroleum Corp.	Artesia, N. M.	Natural gas products	10 MM cu.ft./day input	On stream; designed to recover about 42,000 gal./day liquids.

Petroleum and Natural Gas Products—*Continued*

Company	Location	Products	Capacity	Status and Remarks
Humble Oil & Refining Co.	Bayonne, N. J.	Asphalt		New still on stream.
Humble Oil & Refining Co.	Crane County, Tex.	Natural gas products	40 MM SCFD input	Processing plant due completed late 1961.
Humble Oil & Refining Co.	Hennessey, Okla.	Processed natural gas	62 MM cu.ft./day	Due completed by end of 1961.
Humble Oil & Refining Co.	Kingsville, Tex.	Natural gas products	950 MM cu.ft./day input	King Ranch gas plant, on stream.
Humble Oil & Refining Co. Standard Oil Co. of California	Gaviota, Calif.	Natural gas products	30 MM SCFD input	$500,000 plant due completed Oct. 1961.
Hunt Oil Co.	McGregor, N. D.	Propane Butanes Natural gasoline Sulfur	15,000 gal./day 10,000 gal./day 7,000 gal./day 8 long tons/day	$2-million natural gas processing plant planned.
Husky Oil Co.	Cody, Wyo.	Refinery products		$7.5-million expansion completed.
Ingersoll Corp.	Dimmitt County, Tex.	LPG, gasoline	7,000 gal./day	$250,000 unit under construction.
International Refineries Inc.	Wrenshall, Minn.	Propane		$350,000 plant completed.
Kerr-McGee Oil Industries, Inc.	Navajo, Ariz.	Helium	200,000 cu.ft./day	Due on stream Nov. 1961; will be U. S.'s first privately owned helium plant.
Linde Co.	Amarillo, Tex.	Helium, liquid	100 liters/hr.	Due completed Jan. 1962, will cost about $1 million.
Lone Star Gas Co.	Hamilton County, Tex.	Dry natural gas	27 MM SCFD input	Dehydration plant on stream.
Lone Star Gas Co.	Palo Pinto County,	Dry natural gas	100 MM cu.ft./day input	Dehydration plant due completed Nov. 1961.
Lone Star Gas Co.	Parker County, Tex.	Dry natural gas	100 MM cu.ft./day input	Dehydration plant due completed Nov. 1961.
Midland Cooperatives, Inc.	Cushing, Okla.	Alkylate	1,300 bbl./day	HF alkylation unit on stream.
Murphy Corp.	Superior, Wis.	Petroleum products		Expansion project will include 5,000-bbl./day catalytic cracker, 1,200-bbl./day alkylation unit and other facilities.
Odessa Natural Gasoline Co., Warren Petroleum	Midland County, Tex.	Natural gas products	15 MM SCFD input	$1.4-million plant on stream.
The Ohio Oil Co.	Mosherville, Mich.	Natural gas products	Exp. to abt. 38 MM cu.ft./day input	50% expansion due completed fall 1961.
The Ohio Oil Co.	Robinson, Ill.	Refinery intermediates	Exp. to 55,000 bbl./day input	Completed modernization of crude distillation unit and expansion of catalytic cracker increase crude capacity 10%
Phillips Petroleum Co.	Erath County, Tex.	Propane, butane, natural gas.	50,000 gal./day	Natural-gas-processing plant on stream with input capacity of 25 MM cu.ft./day
Phillips Petroleum Co.	Great Falls, Mont.	Petroleum products		Refinery expansion, due completed early 1962, will include cat cracker, treater.
Phillips Petroleum Co.	Kansas City, Kan.	Alkylate	6,000 bbl./day	HF alkylation unit on stream.
Phillips Petroleum Co.	Phillips, Tex.	Refinery intermediates		25,000-bbl./day catalytic cracker on stream; can treat heavy oils.
Phillips Petroleum Co.	Woods Cross, Utah	Alkylate		Planned alkylation unit will cost $1.5-2.0 million; due completed mid-1962.
Port Gas & Processing Co.	Port Arthur, Tex.	Ethane-propane mixture, butane, natural gasoline	150 MM cu.ft./day input	Due completed mid-1961.
Powerine Oil Co.	Los Angeles, Calif.	Gasoline	2,200 bbl./day input	$2.5-million unit on stream, uses UOP Lomax hydrocracking process.
Pure Oil Co.	Newark, Ohio	Alkylate	1,425 bbl./day input	HF alkylation unit due early 1962.
Quaker State Oil Refining Co.	St. Marys, W. Va.	Propane, liquid		Due completed end of 1961.
Republic Natural Gas Co.	Texas County, Okla.	Natural gasoline, heavier hydrocarbons		Natural-gas extraction plant completed.
Shell Oil Co.	Cass County, Tex.	Natural gas liquids Sulfur	5,000 bbl./day 130 long tons/day	Due on stream Nov. 1961; will process 30 MM cu.ft./day natural gas.
Shell Oil Co.	Martinez, Calif.	Asphalt products	10,000 bbl./day input	Processing plant due on stream Oct. 1961, will cost over $1 million.
Shell Oil Co.	Martinez, Calif.	Lubricating oils	5,000 bbl./day	Hydrotreater under construction.
Shell Oil Co.	Sealy, Tex.	Processed natural gas	15 MM cu.ft./day input	Construction contract awarded; due on stream fall 1961.
Shell Oil Co.	Smyrna, Del.	Refinery products		$80-million refinery planned.
Shell Oil Co., others	Karnes County, Tex.	Natural gas products	16 MM cu.ft./day input	Planned $1.5-million plant will be built and operated by 50%-owner, Shell.
Shell Oil Co., others	Ysecloskey, La.	Natural gas products	450 MM cu.ft./day input	Due completed mid-1962, plant will recover 10,000 bbl./day liquids. Owned by Shell plus six other firms; will be operated by Shell.
Signal Oil & Gas Co.	Houston, Tex.	Refinery intermediates	60,000 bbl./day input	Combination crude distillation, vacuum and visbreaker unit due completed late 1961.
Sinclair Refining Co.	Houston, Tex.	Refinery intermediates	60,000 bbl./day input	New atmospheric and vacuum distillation towers for crude unit due on stream Oct. 1961. Will replace current facilities.
Skelly Oil Co.	Mineola, Kan.	Natural gas products	25 MM SCFD input	On stream.
Socony Mobil Oil Co.	Beaumont, Tex.	Coke	800 tons/day	Delayed coker completed.
South Louisiana Production Co.	St. Landry, La.	Natural gas products	40 MM cu.ft./day input	$1-million unit due completed Dec. 1961. Slated to recover 484 bbl. propane, 278 bbl. butane and 107 bbl. gasoline daily.
Standard Oil Co. of California	Hawaii	Refinery products	20,000 bbl./day input	Partially on stream while construction continues.
Standard Oil Co. of California	Kenai Peninsula, Alaska	Refinery products	20,000 bbl./day input	Planned unit expected to be Alaska's first major oil refinery.
The Standard Oil Co. (Ohio)	Cleveland, Ohio	Gasoline		$750,000 automatic blending system due completed by end of 1961.
The Standard Oil Co. (Ohio)	Toledo, Ohio	Gasoline	7,500 bbl./day input	$5-million unit due on stream late 1961, will use California Research's Isocracking process.
Sun Oil Co.	Marcus Hook, Pa.	Dry gas Propane, propylene Butane Gasoline	14.4 MM cu.ft./day 7,100 bbl./day 13,200 bbl./day 18,000 bbl./day	$9.3-million gas plant due completed Nov. 1961.
Sun Oil Co.	Toledo, Ohio	Propane stock	10,500 bbl./day	$3.6-million deasphalter on stream.
Tenneco Oil Co.	Palacious, Tex.	Natural gas products	70 MM cu.ft./day	On stream; company is planning to increase capacity to 90 MM cu.ft./day.
Texaco Inc.	Los Angeles, Calif.	Refinery intermediates	12,000 bbl./day	$5.6-million hydrotreating on stream.
Texaco Inc.	Port Arthur, Tex.	Kerosene	12,000 bbl./day	New hydrotreater on stream.
Texas Natural Gas Corp.	Shreveport, La.	Natural gasoline	125,000 gal./day	Essentially completed summer 1961.

Petroleum and Natural Gas Products—*Continued*

Company	Location	Products	Capacity	Status and Remarks
Tidewater Oil Co.	Avon, Calif.	Gasoline	20,000 bbl./day	$20-million project will utilize California Research's Isocracking process. Due completed mid-1962; will include 50-MM-cu.ft./day hydrogen plant.
Union Oil Co. of California	Los Angeles, Calif.	Gasoline, distillate fuels		$1.5-million electronic system for in-line blending on stream.
Union Pacific Railroad	Sweetwater County, Wyo.	Natural gas products		$3-million plant planned, to help conserve gas currently flared.
Union Texas Natural Gas Corp.	Eunice, La.	Natural gas products	Exp. to 800 MM cu.ft./day input	Expanded plant is producing 307,000 gal./day ethane, and 550,000 gal./day LPG and natural gasoline.
Union Texas Natural Gas Corp.	Haughton, La.	Natural gas liquids	125,000 gal./day	Due completed July 1, 1961; will have input capacity of over 150 MM cu.ft./day.
Union Texas Natural Gas Corp.	Rayne, La.	Natural gas products	700 MM cu.ft./day	On stream.
United Refining Co.	Warren, Pa.	Alkylate	1,100 bbl./day	Sulfuric-acid-alkylation unit on stream.
Western Frontier Oil & Refining Co.	Anchorage, Alaska	Refinery products	2,500 bbl./day input	Topping plant, due on stream Sept. 1961, will yield gasoline, kerosene, jet fuel, diesel oil and fuel oil.
Westland Oil Co.	Williston, N. D.	Refinery stocks	3,000 bbl./day	Planned $300,000 UOP Unifining unit will expand refinery treating capacity 100%.

Plastics, Resins and Synthetic Fibers

Company	Location	Products	Capacity	Status and Remarks
Air Reduction Chemical & Carbide Co.	City of Industry, Calif.	Vinyl emulsions and resins		$300,000 plant on stream.
Allied Chemical Corp.	Baton Rouge, La.	Polyethers	20 MM lb./yr.	On stream.
Allied Chemical Corp.	Irmo, S. C.	Nylon 6 fine-denier fiber		Due on stream Dec. 1961.
Allied Chemical Corp.	Edgewater, N. J.	Rigid urethane foams		Planned.
Allied Chemical Corp.	Pottsville, Pa.	Plastics films		Converted plant, due on stream late 1961, will initially make fluorohalocarbon and polyamide films.
American Cyanamid Co.	Fortier, La.	Methacrylates	30–35 MM lb./yr.	Due on stream 1963.
Amoco Chemicals Corp.	Texas City, Tex.	Hydrocarbon resins		Due completed fall 1961.
Amoco Chemicals Corp.	Wood River, Ill.	Polybutenes	30 MM lb./yr.	On stream, expands company's polybutene capacity 60%.
AviSun Corp.	New Castle, Del.	Polypropylene	100 MM lb./yr.	Plant completed.
Brand Plastics Co.	Willow Springs, Ill.	Polystyrene	40 MM lb./yr.	Plant completed.
California Chemical Co.	Richmond, Calif.	Polybutenes	Exp. to 50 MM lb./yr.	Expansion due completed mid-1961.
Cary Chemicals Inc.	Midwest	Polyvinyl chloride	50 MM lb./yr.	Planned.
Cary Chemicals Inc.	New Jersey	Polyvinyl chloride	100 MM lb./yr.	Planned.
Celanese Corp. of America	Bishop, Tex.	Polyacetal resin	20 MM lb./yr.	On stream late 1961.
Celanese Polymer Co.	Houston, Tex.	Polyethylene	Exp. to 60 MM lb./yr.	20% expansion completed, adds new line of high-density polyethylenes.
Chemstrand Corp.	Greenwood, S. C.	Nylon-66 yarn	Exp. to 40 MM lb./yr.	200% expansion due completed May 1962.
Dow Chemical Co.	Bay City, Mich.	Polyolefins		Expansion completed.
Dow Chemical Co.	Plaquemine, La.	Polyolefins		$6-million plant, the second polyolefins unit at site, due second quarter 1962.
Dow Chemical Co.	Torrance, Calif.	Polypropylene	25 MM lb./yr.	Plant completed.
E. I. du Pont de Nemours & Co.	Florence, S. C.	Polyester film		$20-million plant due on stream 1961.
E. I. du Pont de Nemours & Co.	Orange, Tex.	Polyethylene, high-pressure	Exp. to 280 MM lb./yr.	Due on stream late 1962; 40% expansion of polyethylene capacity.
		Ethylene-vinyl acetate copolymer		
E. I. du Pont de Nemours & Co.	Richmond, Va.	Polyethylene film	Exp. to over 60 MM lb./yr.	Expansion, due completed 1962, will double capacity.
E. I. du Pont de Nemours & Co.	Victoria, Tex.	Polyethylene, high pressure		Multimillion-lb./yr. plant on stream, and additional unit is under construction.
E. I. du Pont de Nemours & Co.	Waynesboro, Va.	Spandex fiber and elastomer		Sixfold expansion under way.
Firestone Plastics Co.	Hopewell, Va.	Nylon	Exp. to 15-18 MM lb./yr.	50% expansion planned.
Firestone Plastics Co.	Pottstown, Pa.	Polyvinyl chloride		Expansion completed, increasing firm's resin-and-latex capacity about 20%.
Firestone Synthetic Fibers Co.	Hopewell, Va.	Nylon filament, lofted		On stream.
General Electric Co.	Pittsfield, Mass.	Phenolic molding compounds		$750,000 expansion, due completed 1962, will increase plant capacity 30%'
The B. F. Goodrich Co.	Long Beach, Calif.	Polyvinyl chloride		Expansion completed.
The B. F. Goodrich Co.	Louisville, Ky.	Vinyl resin		Plant completed, makes high-temp. resin.
W. R. Grace & Co.	Acton, Mass.	Polyvinylidene polymer		On stream.
W. R. Grace & Co.	Baton Rouge, La.	Polyethylene		Multimillion-dollar expansion due completed Aug. 1961.
Hercules Powder Co.	Covington, Va.	Polypropylene fiber	10–12 MM lb./yr.	On stream with above capacity; further expansion due completed fall 1961.
Hercules Powder Co.	Lake Charles, La.	Polyolefins	Exp. to 120 MM lb./yr.	Second multimillion-dollar polyolefins unit under construction; first unit (60 MM lb./yr.) placed on stream.
Humble Oil & Refining Co.	Baytown, Tex.	Polyolefins	Exp. to 80 MM lb./yr.	Project includes intermediate 50% expansion to 60 MM lb./yr., followed by expansion to 80 MM lb./yr. by late 1962.
Molded Fiber Glass Cos.	Ashtabula, Ohio	Polyester resins	Exp. to 10 MM lb./yr.	Expansion completed, doubling capacity.
Monsanto Chemical Co.	Addyston, Ohio	Styrene-based plastics	50 MM lb./yr.	Due on stream late 1961.
Monsanto Chemical Co.	Texas City, Tex.	Polyethylene	130 MM lb./yr.	30% expansion of high-pressure-process plant due completed early 1962.
Montecatini	Neal, W. Va.	Polypropylene fiber	25 MM lb./yr.	Due on stream early 1963.
National Petro Chemicals Corp.	Houston, Tex.	Polyethylene, high-density	60 MM lb./yr.	$15-million plant due on stream late 1962.
Nopco Chemical Co.	Chattanooga, Tenn.	Polyether urethane foam	4 MM lb./yr.	On stream.
Nopco Chemical Co.	Midwest	Polyether urethane foam		Planned.
Phillips Petroleum Co.	Houston, Tex.	Polyethylene		Expansion will produce new extrusion resin.
Rexall Chemical Co.	Northern Illinois	Polystyrene	25 MM lb./yr.	Due on stream mid-1961.
Rexall Chemical Co.	Odessa, Tex.	Polypropylene		Planned.

Plastics, Resins and Synthetic Fibers

Company	Location	Products	Capacity	Status and Remarks
Reynolds Metals Co.	Grottoes, Va.	Polyvinyl chloride film		Current expansion program, nearly completed, will be followed by another one that will triple capacity by end of 1961.
Rogers Corp.	Manchester, Conn.	Diallyl phthalate molding compounds		100% expansion due completed Aug. 1961.
Shawinigan Resins Corp.	Springfield, Mass.	Polyvinyl resins		$2-million expansion planned.
Shell Chemical Co.	Wallingford, Conn.	Polystyrene	40 MM lb./yr.	On stream.
Shell Chemical Co.	Woodbury, N. J.	Polypropylene	80 MM lb./yr.	Due on stream mid-1962.
Spencer Chemical Co.	Calumet City, Ill.	Polyethylene latex	20 MM lb./yr.	$1-million plant, due on stream early 1962, with undisclosed polymerization process.
Tennessee Eastman Co.	Kingsport, Tenn.	Polyester fiber	20 MM lb./yr.	Plant completed.
Terrafilm Corp.	Rockland Co., N. Y.	Polyester film	1–3 MM lb./yr.	Under construction.
Texas Butadiene & Chemical Co.	Miami, Fla.	Styrene-maleic anhyd. resins		Under construction.
Texas Eastman Co.	Longview, Tex.	Polypropylene	20 MM lb./yr.	On stream.
U. S. Rubber Co.	Gastonia, N. C.	Urethane elastic thread		Expansion, doubling capacity, due completed late Aug. 1961; further expansion due completed by end of 1961.
Valchem	Langley, S. C.	Polyester resins	3 MM lb./yr.	Plant completed.
Verona Chemical Corp.	Newark, N. J.	Polyester resins	1 MM lb./yr.	Plant completed.
Wyandotte Chemicals Corp.	Washington, N. J.	Polyester products		On stream; additional expansion due completed Sept. 1, 1961.

Pulp and Paper

Company	Location	Products	Capacity	Status and Remarks
Bowaters Carolina Corp.	Catawba, S. C.	Pulp and paper		Under construction.
Brown Co.	Gorham, N. H.	Sanitary tissue		101-in. paper machine due in operation by May 1962, expanding plant output.
Brunswick Pulp & Paper Corp.	Brunswick, Ga.	Paper		Currently adding papermaking capacity to pulp mill.
Crossett Paper Mills	Crossett, Ark.	Coated bleached footboard	Exp. by 160 ton /day	New 216-in. cylinder machine in operation.
Crown Zellerbach Corp.	Bogalusa, La.	Pulp and paper		$8.2-million modernization and diversification planned.
Diamond National Corp.	Middletown, Ohio	Molded pulp		$6-million plant due on stream by mid-1962.
Dierks Forest, Inc.	Broken Bow, Okla.	Insulating board	400,000 sq.ft./day	New machine on stream.
Fiberboard Paper Products Corp.	Antioch, Calif.	Kraft pulp, paperboard		New units on stream, boost overall mill capacity to over 200,000 tons/yr.
Fitchburg Paper Co.	Westminster, Mass.	Paper		$1.4-million plant due completed Sept. 1961.
Fraser Co.	Madawaska, Me.	Paper	Exp. 40,000 tons/yr.	New paper machine in operation.
Garden State Paper Co.	Garfield, N. J.	Newsprint		Due on stream by Jan. 1962, will incorporate new process for treating old newspapers.
Georgia-Pacific Corp.	Samoa, Calif.	Kraft pulp	300 tons/day	Planned.
Grays Harbor Paper Co.	Grays Harbor, Wash.	Fine papers		Second paper machine due late 1961.
Inland Empire Paper Co.	Millwood, Wash.	Bleached sulfite pulp	50 tons/day	Due on stream Nov. 1961.
International Paper Co.	Gardiner, Ore.	Pulp		Planned.
International Paper Co.	Natchez, Miss.	Cellulose pulp		Additional equipment being installed will improve quality of product, which is used to make rayon tire cord.
International Paper Co.	Moss Point, Miss.	Paper products		$3.5-million modernization due completed by early 1962.
Kimberly-Clark Corp.	Anderson, Calif.	Kraft pulp and paper		Mill planned.
Kimberly-Clark Corp.	Dayton, Ohio	Paper		Second paper machine in operation, making offset, bond and envelope papers.
Kimberly-Clark Corp.	Neenah, Wis.	Paper	Exp. by 35 tons/day	New machine in operation.
Kimberly-Clark Corp.	Niagara, Wis.	Coated paper	Exp. by 500 tons/day	Fourth machine, with a 168-in. wire, due for startup late 1961.
Kimberly-Clark Corp.	Niagara, Wis.	Paper		Paper machine due on stream 1962 or 1963
Kimberly-Clark Corp.	West Carrolton, Ohio.	Paper		Paper machine due on stream 1962 or 1963.
Menasha Wooden Ware Corp.	North Bend, Ore.	Corrugating paper	125 tons/day	Plant completed.
Noralyn Paper Mills	Beuche, La.	Newsprint	400 tons/day	$36-million mill due on stream by end of 1962.
		Semichemical pulp		
Potlach Forests, Inc.	Lewiston, Idaho	Kraft pulp	300 tons/day	Will install continuous vertical digester.
Puget Sound Pulp & Timber Co.	Bellingham, Wash.	Tissue		New forming equipment.
Rayonier, Inc.	Fernandina Beach, Fla.	Pulp, pulp products		Conversion under way, will broaden mill's product line.
Rayonier, Inc.	Grays Harbor, Wash.	Pulp		New sodium-base sulfite equipment and bleach plant due on stream fall 1961.
Rayonier, Inc.	Hoquiam, Wash.	Bleached pulp	200 tons/day	Construction on $2.4-million plant, replacing older facilities, underway. Project includes 500-ton/day recovery plant, due completed by end of 1961.
Rayonier, Inc.	Jessup, Ga.	Cellulose pulp		Due on stream late 1961; product is used to make tire cord.
Red River Paper Mill	Springhill, La.	Bleached paperboard	250 tons/day	Planned.
St. Francisville Paper Co.	St. Francisville, La.	Coated printing paper	Exp. to 160,000 tons/yr.	Planned $25-million expansion will double capacity; includes a second paper machine
St. Regis Paper Co.	Tacoma, Wash.	Pulp	Exp. by 325 tons/day	$30-million expansion completed.
		Paper, paperboard	Exp. by 400 tons/day	
Scott Paper Co.	Mobile, Ala.	Paper	200 tons/day	Fourdrinier machine in operation.
Southern Land Timber & Pulp Corp.	Georgia	Newsprint	100,000 tons/yr.	Under construction; newsprint machine due on stream by end of 1963.
		Kraft liner-board		
Southwest Forest Industries, Inc.	Snowflake, Ariz.	Kraft pulp, newsprint	75,000 tons/yr.	Due completed this year.
Stone Container Corp.	Coshocton, Ohio	Corrugated liners	150 tons/day	Plant uses new cold-soda pulping process.
Tennessee River Pulp & Paper Co.	Counce, Tenn.	Kraft pulp and linerboard	500 tons/day	$41-million plant on stream.
U. S. Plywood Corp.	Gold Beach, Ore.	Pulp and paper	500 tons/day	Planned.
West Virginia Pulp & Paper Co.	Luke, Md.	Pulp and paper		$55-million mill on stream.
Weston Paper & Mfg. Co.	Terra Haute, Ind.	Semichemical pulp	135 tons/day	Plant modernization completed, allowing conversion from straw to hardwood feed.
Weyerhaeuser Timber Co.	Longview, Wash.	Paperboard		$10-million project includes 20% capacity increase, due completed by Dec. 1961.

Please turn to p. 202

Barges carrying liquid sulphur head up the Mississippi River

NEW LIQUID SULPHUR SERVICE HELPS USERS CUT HANDLING LOSSES

With the inauguration of new terminals on the inland waterways, in Florida and along the Atlantic seaboard, Freeport now offers customers a greatly expanded service in the delivery of liquid sulphur.

More and more, consumers are changing over to receiving sulphur in liquid form rather than the traditional solid lump form.

The benefits are tangible. With liquid sulphur you *eliminate* remelting costs, handling losses, dust and dust-causing corrosion, stockpile erosion and contamination.

Write for a copy of our new 24 page booklet **"Liquid Sulphur from Freeport"**

Upon request, Freeport will be glad to survey the feasibility and advantages of converting to liquid sulphur at your plant.

FREEPORT SULPHUR COMPANY

161 East 42nd Street, New York 17, New York

THE LOUISIANA SULPHUR unloads liquid at the Tampa, Florida, terminal

Rubber

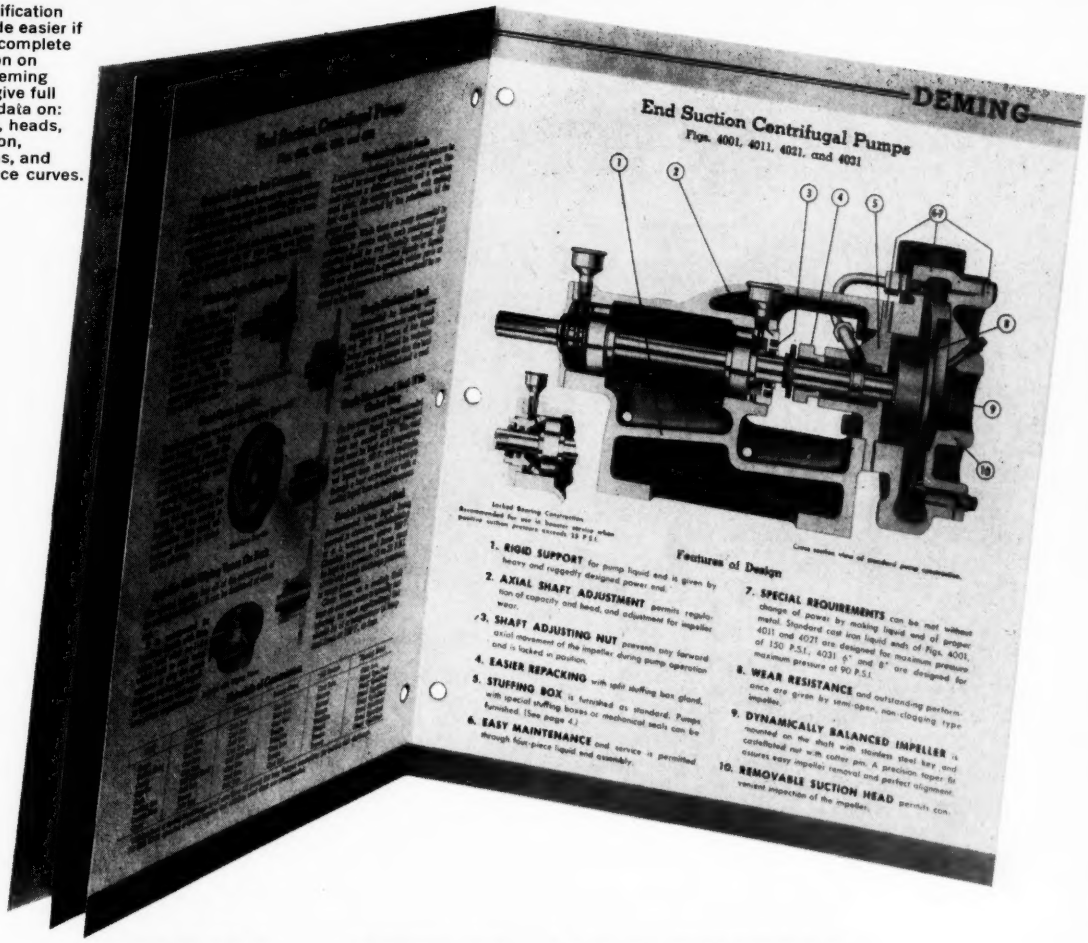
Company	Location	Products	Capacity	Status and Remarks
Copolymer Rubber & Chemical Corp.	Baton Rouge, La.	Styrene-butadiene rubber	Exp. to 133,000 long tons/yr.	$5-million, 40% expansion completed.
E. I. du Pont de Nemours & Co.	Beaumont, Tex.	Ethylene-propylene rubber		Due on stream 1963.
Firestone Tire & Rubber Co.	Orange, Tex.	Synthetic rubber	30,000 long tons/yr.	Multimillion-dollar plant on stream, produces stereospecific polymers of either butadiene or isoprene.
The B. F. Goodrich Co.	Akron, Ohio	Tires		$2-million expansion and modernization due completed by end of 1961.
Goodrich-Gulf Chemicals, Inc.	Beaumont, Tex.	Polybutadiene	20,000 tons/yr.	Polybutadiene unit due on stream late 1961,
		Polyisoprene	20,000 tons/yr.	polyisoprene unit due on stream 1962.
Goodrich-Gulf Chemicals, Inc.	Institute, W. Va.	Polybutadiene, cis	20 MM lb./yr.	Due 1962; conversion of SBR plant.
Goodyear Tire & Rubber Co.	Beaumont, Tex.	Polybutadiene	20,000 long tons/yr.	Polybutadiene production due to start Oct. 1961; polyisoprene production will start 1962.
		Polyisoprene	20,000 long tons/yr.	
		Isoprene monomer		
Goodyear Tire & Rubber Co.	Houston, Tex.	Rubber polymers	Exp. by 16,000 long tons/yr.	$1.3-million addition of finishing line for new polymers is on stream.
Humble Oil & Refining Co.	Baytown, Tex.	Butyl rubber		Expansion completed.
Ohio Rubber Co.	Fort Smith, Ark.	Rubber		Under construction.
Phillips Petroleum Co.	Borger, Tex.	Polybutadiene	25,000 long tons/yr.	Due on stream 1961.
Shell Chemical Co.	Marietta, Ohio	Polyisoprene	35,000 long tons/yr.	Due on stream 1962.
Shell Chemical Co.	Torrance, Calif.	Polybutadiene	18,000 long tons/yr.	Due on stream by 1965.
Shell Chemical Co.	Torrance, Calif.	Polyisoprene	18,000 long tons/yr.	Due on stream 1961.
U. S. Rubber Co.	Baton Rouge, La.	Stereo rubbers		$2-million semiworks unit for batch polymerization under construction.

Miscellaneous

Company	Location	Products	Capacity	Status and Remarks
Air Products & Chemicals, Inc.	Minneapolis, Minn.	Industrial and medical gases		Under construction.
Allied Chemical Corp.	Baltimore, Md.	Herbicides		On stream.
American-Marietta Co.	Richmond, Calif.	Resins and adhesives	28 MM lb./yr.	$600,000 plant on stream.
The American Sugar Refining Co.	Boston, Mass.	Cane sugar	2 MM lb./day	On stream.
Arabol Mfg. Co.	Portland, Ore.	Adhesives		On stream.
California Chemical Co.	Oak Point, La.	Lubricating-oil additive		$1-million expansion due completed 1961.
Mary Carter Paint Co.	Chino, Calif.	Paints	1 MM gal./yr.	Due on stream summer 1961.
Columbia Vegetable Oils	Quincy, Wash.	Soybean oil	10 MM lb./yr.	Due on stream early 1962.
		Soybean meal and flour	45 MM lb./yr.	
Fibrous Glass Products, Inc.	Wilkes-Barre, Pa.	Glass fiber	10 MM lb./yr.	$1.8-million plant due on stream by Jan. 1962.
General Electric Co.	Waterford, N. Y.	Intermediate silicone chems.		$1-million plant due completed Sept. 1961.
W. R. Grace & Co.	Owensboro, Ky.	Specially felted fibers		$1-million expansion planned.
Heyden Newport Chemical Corp.	Garfield, N. J.	Epoxy resin chemicals		Planned.
Interchemical Corp.	Charlotte, N. C.	Industrial finishes, printing inks, textile dyes		Under construction.
Jefferson Lake Asbestos Corp.	Calaveras Co., Calif.	Asbestos	2,500 tons/day	$5-million plant due on stream Mar. 1962
Johns-Manville Corp.	Parkersburg, W. Va.	Glass-fiber home insulation		Expansion completed.
Johns-Manville Corp.	Waterville, Ohio	Textile fiber glass		40% expansion planned.
Merck & Co.	Danville, Pa.	Silicone wafers		Under construction; product used as semiconductor.
North American Aviation, Inc.	Oxnard, Calif.	Fresh water	15,000–20,000	$250,000 desalination plant planned, will employ freezing by butane injection.
Oak Ridge National Laboratory	Oak Ridge, Tenn.	Stable isotopes		Sixfold expansion of separation facilities completed.
Procter & Gamble Co.	Augusta, Ga.	Synthetic detergents		$4-million plant due on stream early 1963.
Proctor Chemical Co.	Salisbury, N. C.	Resins and chemicals		Contract awarded for $250,000 expansion to produce products for textile and chemical industries. Products include thermosetting resins and anhydroaneaheptitol.
Putnam Chemical Co.	Charlotte, N. C.	Dyes		Due completed early 1962.
Sun Chemical Corp.	Newark, N. J.	Pigments, intermediates		Due on stream late 1961.
Switzer Bros., Inc.	South El Monte, Calif.	Paints, pigments, printing inks		On stream.
Thiokol Chemical Corp.	Moss Point, Miss.	Chemicals, polymers		Plant completed; products not specified. Adjacent Thiokol unit makes liquid polysulfides.
Trubek Labs.	East Rutherford, N. J.	Anti-ozonant intermediates		$250,000 expansion planned.
U. S. Dept. of Interior	Freeport, Tex.	Fresh water	1 MM gal./day	On stream, uses vertical evaporators to treat salt water.
U. S. Dept. of Interior	Webster, S. D.	Fresh water	250,000 gal./day	Due onstream Oct. 1961, plant will use electrodialysis to desalinate brackish water.
U. S. Dept. of Interior	Wrightsville Beach, N. C.	Fresh water	250,000 gal./day	Design-and-engineering contract awarded for plant that will use freezing to desalinate sea water.
U. S. Dept. of Interior; Calif. Dept. of Water Resources	Point Loma, Calif.	Fresh water	1 MM gal./day	$1.6-million flash-evaporation desalination plant due completed Nov. 1961.
Universal Oil Products Co.	East Rutherford, N. J.	Anti-ozonant additives		$250,000 plant due on stream fall 1961.
Universal Oil Products Co.	Shreveport, La.	Chemicals and catalysts		$1.2-million expansion planned.
Virginia Chemicals & Smelting Co.	West Norfolk, Va.	Hydroxylamine sulfate, sodium m-bisulfite		$625,000 expansion planned.
Witco Chemical Co.	Chicago, Ill.	Detergents		$1.6-million plant on stream.

Reprints: **For your files,** copies of this 11-page table are now available in reprint form. For fastest service just check Reprint No. 191 on your Reader Service Card in this or any subsequent issue. Price for single copies is 50¢

Your specification job is made easier if you have complete information on pumps. Deming bulletins give full technical data on: capacities, heads, construction, dimensions, and performance curves.


DEMING
End Suction Centrifugal Pumps
Figs. 4001, 4011, 4021, and 4031
Features of Design
1. RIGID SUPPORT for pump liquid end is given by heavy and ruggedly designed power end.
2. AXIAL SHAFT ADJUSTMENT permits regulation of capacity and head, and adjustment for impeller wear.
3. SHAFT ADJUSTING NUT prevents any forward axial movement of the impeller during pump operation and is locked in position.
4. EASIER REPACKING with split stuffing box gland.
5. STUFFING BOX is furnished as standard. Pumps with special stuffing boxes or mechanical seals can be furnished. (See page 4.)
6. EASY MAINTENANCE and service is permitted through four-piece liquid end assembly.
7. SPECIAL REQUIREMENTS can be met without change of power by making liquid end of proper metal. Standard cast iron liquid ends of Figs. 4001, 4011 and 4021 are designed for maximum pressure of 150 P.S.I.; 4031 6" and 8" are designed for maximum pressure of 90 P.S.I.
8. WEAR RESISTANCE and outstanding performance are given by semi-open, non-clogging type impeller.
9. DYNAMICALLY BALANCED IMPELLER is mounted on the shaft with stainless steel key and castellated nut with cotter pin. A precision taper fit assures easy impeller removal and perfect alignment.
10. REMOVABLE SUCTION HEAD permits convenient inspection of the impeller.

NOW...SEE WHY DEMING can pump your liquids at lowest cost

Here is pump information you can use when it's time to talk pumps in your company . . . or when it's time to specify. Up-to-the-minute Deming Bulletins covering immersion process pumps, vertical turbines, centrifugals, rotaries and other Deming quality pumps show you specifically why a Deming will handle the job efficiently . . . and at lowest cost.

Is corrosion your big problem? Power cost? Space? Transfer loading? . . . Do you pump acids? Abrasive slurries? Asphalt thick mixtures? Xylene thin solvents?

Then send for the literature on the pumps that interest you. With more than 10,000 Deming pump types, capacities and sizes to choose from, you have good reason to make Deming your headquarters for pumps and pump information. Buyers throughout the country rely on Deming.

DEMING
DIVISION CRANE CO.
950 Broadway • Salem, Ohio

Send the reply form now . . . and have the facts when you need them.

PLEASE SEND information on the following:

- ☐ Deming Vertical Turbines (or circle 203a on Reader Service Card)
- ☐ Deming End Suction Centrifugal Pumps (or circle 203b on Reader Service Card)
- ☐ Deming Sump Pumps (or circle 203c on Reader Service Card)
- ☐ Deming Internal Gear Rotary Pumps (or circle 203d on Reader Service Card)
- ☐ Deming Submersible Pumps (or circle 203e on Reader Service Card)

Name_____

Title_____

Company_____

Address_____

City_____ Zone____ State_____

You & Your Job

Will Your Next Move Be Easy to Make?

For the chemical engineer in search of a job, whether he's currently employed or not, the driving force is job mobility.

And anything that increases job mobility—cuts such resistances that hamper it—helps the jobseeker. Since job mobility has an important bearing on your professional and economic welfare, we've called your attention in the past to ways that may improve it.

▶**New, Easy Way**—For example, last year before the coincidental annual meetings of the American Institute of Chemical Engineers and the American Rocket Society in Washington, we discussed the "career center" set up for those meetings (*Chem. Eng.*, Nov. 28, 1960, p. 154).

At the career center, interviewing firms pay all fees, the individual engineer pays nothing. Your resume, without your name and firm, is examined by interested companies. If they're interested in you, and you in them, you report for the interview; otherwise, they never find out who you are.

In Washington last December, process industry firms, among others, interviewed 439 engineers and scientists, mostly younger B.S. degree men. But experience of these people ranged up to more than 20 years, salary ranged from $5,000 to over $20,000.

The man who runs the career centers at various national meetings is William Douglass, president of Careers Inc., New York. After experience at such technical affairs as WESCON and the annual March IRE show, he claims that some semblence of hiring dignity has been restored to meetings at which pirating of engineering talent was becoming outrageous.

▶**Industry Pulsebeat**—For that same reason, the firm responsible for the engineer/scientist demand index (*Chem. Eng.*, Aug. 7, p. 140) claims that there is need for tighter ethical restraints on present technical meeting recruiting activity. In a letter to society executives last spring, Deutsch & Shea, Inc., New York, asked for society support in a proposed one-year ban on such recruiting.

Said Deutsch & Shea vice-president Van Evans: "Recruiting at conventions has gotten out of hand as competitive pressure has increased. Recent years have seen a sharp rise in lavish hospitality suites, stunts and gimmicks, massive advertising, hiring-hall procedures and other techniques more suitable for high-pressure sales exhibitions than for professional conferences."

To support its contention that recruiting had tended to undermine the original purpose of professional meetings, Deutsch & Shea surveyed 200 industrial firms active in recruiting. It wished to test opinion on whether a trial ban on recruiting could be supported.

Though the advertising firm found that 3 out of 4 firms of the total respondents think it would be desirable to ban recruiting at major professional meetings, the sample was weighted rather heavily to firms in aerospace and electronics industries. Chemical companies split almost half and half on this key question of the survey.

Of the 23 out of 27 chemical firms who recruit at meetings, half do so at two meetings each year, another third at three. Four-fifths of the 27 chemical-firm responders claimed they would join in a trial one-year ban, and would recommend that their firms cease altogether if the industry generally agreed to it. The agreement might be harder to come by, however, then

Fischer & Porter's

NEW IN-LINE BLENDING SYSTEMS

MIX FLUIDS RIGHT IN A PIPELINE

Eliminate batch mixing, holding tanks, trimming

Control total quantity ratios by an electronic "memory"

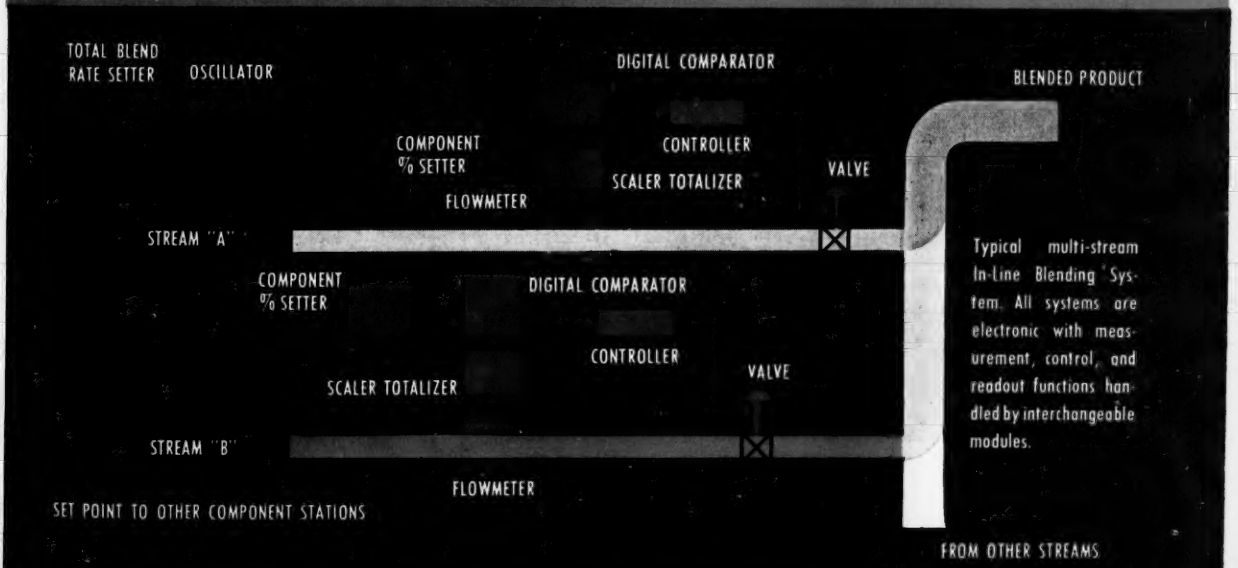
Give a system accuracy of better than ±½%

These new electronic In-Line Blending Systems let you blend two or more fluids — automatically and continuously in a pipeline — with greater accuracy than ever before. Each system combines flowmeters, interchangeable transistorized readout devices and electronic control units to give you a complete, packaged, blending facility from a single source — Fischer & Porter Company.

Each of these unique systems has a memory — that is, it "remembers" how much of any one ingredient has been added to the main stream. Then it goes on to compensate, continuously, for any deviations from the required total blend ratio, whether plus or minus, with an accuracy better than ±0.5%, a repeatability better than ±0.2%. And it is this memory characteristic which obsoletes older flow rate ratio methods.

Result: fast, precise, flexible systems that enable you to control mixing or blending from feed lines to point-of-use — product pipelines, tankers, whatever. You eliminate wasteful batching operations in between. Many types of systems are available, including the blending of two or more streams for petroleum, chemical, food, or other products-of processing industries.

A description of your interests will bring you complete technical data. And, let us know if you would like to see a typical system in operation here at the plant . . . Fischer & Porter Company, 201 County Line Rd., Warminster, Pa. In Canada, write Fischer & Porter (Canada) Ltd., 2808 Jane St., Toronto.



Typical multi-stream In-Line Blending System. All systems are electronic with measurement, control, and readout functions handled by interchangeable modules.

FP FISCHER & PORTER COMPANY

A world-wide Instrument Company with plants in Australia, Canada, England, France, Germany, Holland, Mexico, and the United States.

a resolution of the Berlin situation.

▶Some Reasons Why—In conversations with recruiters of some of the same firms that were surveyed, CHEMICAL ENGINEERING learned that most are skeptical about the enforcability of either a temporary or permanent recruiting ban. At the same time, they don't believe that chemical industry firms have indulged in the extravagant practices of those that might recruit at WESCON or IRE.

Too, relatively fewer men are probably hired through noncampus recruiting in the chemical industry than in the aerospace and electronics areas.

Another factor seems to be satisfaction with recruiting practice at certain major meetings of interest to the chemical industry. Frequently mentioned by respondents to the Deutsch & Shea survey was the American Chemical Society employment clearing house, which is operated at the spring and fall meetings of ACS.

Said one: "When handled as effectively and as ethically as the American Chemical Society does it, and apparently well-patronized by ACS members, we see no reason for banning such an employment operation."

In figures released after the spring ACS meeting in St. Louis, the society showed 616 employers and 296 job applicants registered, for a ratio of 2.1 employers/applicant. A total of 3,583 interviews was scheduled, for an average of 12.1 per applicant. At the fall meetings, twice as many employers and applicants use the ACS employment clearing house.

As several firms have pointed out to CHEMICAL ENGINEERING, however, the ACS meetings produce relatively few chemical engineers. Most of the applicants at the clearing house are chemists. Nonetheless, at these biggest of all chemical meetings, the main body of the society's membership supports the no-fee service that is provided.

▶What for ChE's?—Unless, then, a chemical engineer is either a member of ACS or of one of the specialized societies where Douglass' career centers are set up, he won't find a formal recruitment procedure at the one big national meeting he may attend.

The effect of this may be perpetuation of practices that have given rise to cries of excessiveness. At the December meeting of AIChE in New York this year, there will be no career center as there was last year in Washington. So even that "out-of-bounds" activity won't be open to engineers.

Out-of-bounds is used advisedly. A long-standing policy of AIChE, reviewed at the 1960 annual meeting when Douglass had a career center, is to prohibit such activity or any cooperation with such activity. Thus, for example, registration cards for the meeting are not available for such a purpose.

In light of industry interest in properly controlled recruiting at such meetings, however, maybe it's time to reevaluate that policy. If you thing so, or if you think not, tell us.

It will only take a few minutes to fill out the coupon at the left and mail it to *CE*. With your response, we may get a little better idea of whether job mobility has any meaning for chemical engineers.

This information will not be used in connection with you personally. Don't sign your name. But by returning the completed form promptly to CHEMICAL ENGINEERING, c/o YYJ Editor, 330 W. 42nd St., New York 36, N.Y., you can help determine the needs of job mobility—yours and your colleagues' throughout the industry. We'll tabulate results and then comment in a future issue.

About You and Your Job:

Job title or function _____ Industry* _____

Years: in present position ____ with firm ____ since entering profession ____

Your age ____ Degree ____ ☐ No ____ ☐ B.S. ____ ☐ M.S. ____ ☐ PhD. ____

Number of previous firms you were with _____

Member of ____ ☐ AIChE ____ ☐ ACS ____ ☐ Other technical society

About Your Last Job Change:

Reason _____

Method ☐ Recruited ☐ Answered ad ☐ Placed ad ☐ Agency ☐ Other

If other, what? _____

Length of time out of work _____ Dollar-cost of change _____

About Changing Your Job:

Which of the following services have you used?	Number of times	Help you land job?
☐ American Chemical Society employment clearing house		
☐ Engineering Societies Personnel Service		
☐ Career Center at a national meeting		

Have you used other society-sponsored employment services? ☐ Yes ☐ No

If yes, what? _____

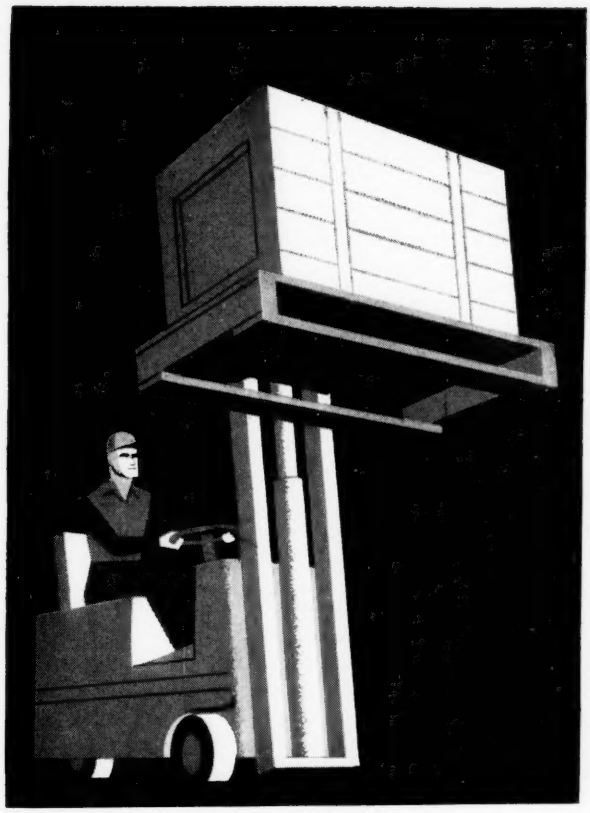
Would you favor AIChE-sponsored employment centers at meetings? ☐ Yes ☐ No

Would you favor other AIChE-sponsored employment services? ☐ Yes ☐ No

If yes, what? _____

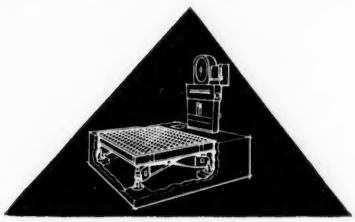
If no, why not? _____

*For industry, use one of following categories of the CPI: Chemicals (including petrochemicals); drugs and medicines; explosives and fireworks; fats and oils; fertilizers and agricultural chemicals; foods and beverages; leather tanning and finishing; lime and cement; man-made fibers; metallurgical and metal products; paints, varnishes, pigments and allied products; petroleum refining and coal products; plastics materials, synthetic resins and nonvulcanizable elastomers; rubber products; soap, glycerin, cleaning, polishing, related products; stone, clay, glass and ceramics; wood, pulp, paper and board; other chemically processed products.



...CUT COSTS AND SAVE TIME WHEN WEIGHING MATERIALS ON POWER OR HAND TRUCKS

FAIRBANKS-MORSE WAREHOUSE SCALES



Self-Contained Scales

- For general use in factories, warehouses, shipping rooms, foundries, paper mills and other industrial applications.
- Thirty different models for your special requirements... with direct-reading "Floaxial" Dials, with or without "Printomatic" weight recorder or with Double Beam. Capacities from 600 lbs. to 3200 lbs.
- All models feature the F-M Type "S" Lever System—a suspension system that swings parallel to the direction of traffic... thus protects scientifically ground pivots and bearings... results in accuracy that lasts for longer periods of time.

Built-In Floor Scales

- Especially designed for heavy-duty use in metal working plants, steel mills, paper mills, textile mills, mines... and for general factory use.
- Available for installation in a pit or suspended from the floor, with direct-reading "Floaxial" Cabinet Dial, with or without "Printomatic" weight recorder, or Double Beam. 20 different models with capacities up to 10 tons.
- All models feature the F-M Type "S" Lever System for complete accuracy over longer periods of time.

For complete information on any or all Self-Contained and Built-in Scales, write: **Dept. S-1; Scale Division; Fairbanks, Morse & Co., 100 Electra Lane, East Station; Yonkers, New York.**

FAIRBANKS MORSE

A MAJOR INDUSTRIAL COMPONENT OF

FAIRBANKS WHITNEY

3,681 chemical engineers in the National Register* reported a median 1960 salary of

$10,000

The group breakdown looks like this:

Field and type of employer		By highest degree	
Education	$10,000	Less than bachelor's	$10,000
Federal government	$10,000	Bachelor's	$10,000
Nonprofit organizations	$10,000	Master's	$11,000
Industry or self-employed	$11,000	Ph. D	$12,000
Function or work activity		**By age group**	
All managers	$13,000	20 to 29	$8,000
R & D managers	$13,000	30 to 39	$10,000
Research, development, design	$10,000	40 to 49	$13,000
Teaching	$9,000	50 to 59	$14,000
Production	$10,000	60 and over	$13,000

* National Register of Scientific and Technical Personnel. Reported in NSF 61-44.

MARKET PRICE OF CHEMICAL ENGINEERS: GOING DOWN?

Government agency's "national register" salaries can't be too-useful criterion.

Last year, CHEMICAL ENGINEERING reported salary data from the Federal Government's national register of scientific and technical personnel (*Chem. Eng.*, June 13, 1960, p. 221).

At that time, we figured chemical engineers at $125,232 per dozen, based on the median figures of the 1956-58 data compiled by the National Science Foundation. Now, the same agency has compiled information on the years 1959 and 1960. And, believe it or not, your salaries seem to have gone down!

Information reported to NSF is gathered by several cooperating societies. For chemical engineers, the American Chemical Society reports. Last year, ACS sent out the questionnaires to qualified member and nonmember professionals, asked them to report salary as of January 1, 1960. The few returns (3,681) show the limitation of the sample, and NSF does not claim comprehensive registration of chemical engineers.

But in one respect, the data may be more significant than it was last time. Rather than asking for actual salary, the request was for salary to the nearest thousand dollars. This phrasing might tend to eliminate one criticism of previous National Register studies: that individuals naturally exaggerate their own salaries, thus forcing the over-all salary curves upward.

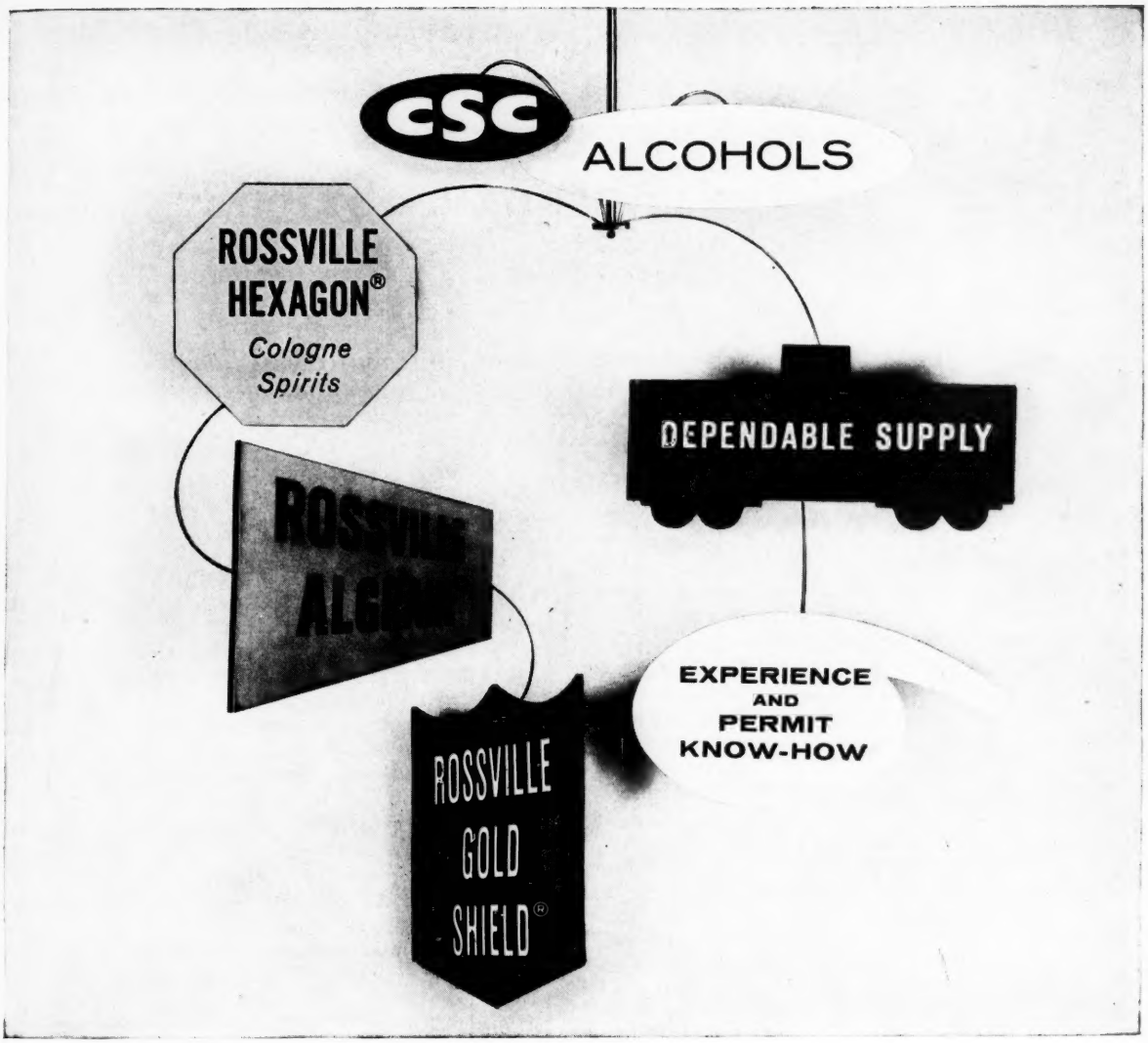
What These Salary Figures Show

Since the data were gathered on a different reporting basis than the 1956-58 study, it's a little deceptive to compare the figures shown in the chart above with those reported before. That's the point at which you conclude that salaries have flattened out over the past several years.

More-comprehensive surveys, however, give the lie to this conclusion. Recently reported here, these include the Engineers Joint Council 1960 report (*Chem. Eng.*, Mar. 20, p. 172) and the National Society of Professional Engineers survey of its own membership (*Chem. Eng.*, Aug. 21, p. 132).

One thing the National Register survey does, however, is make it possible to compare chemical engineering respondents with other scientific fields. There is no other national study in which you can do that. The sciences include—among others—biological, earth, physical and chemical.

Salary figures do not include bonuses, overtime, summer teaching or other sources of professional income.



CSC ethyl alcohols give you a perfect balance of quality and service

CSC Rossville is a name that's been noted for top quality for more than a hundred years. And CSC itself is a name that means top service, right now when you want it. Coast-to-coast, CSC has denaturing plants, sales offices, distribution points, ready for instant delivery of any quantity of ethyl alcohol. With its long experience and service record, CSC is your outstanding alcohol supplier.

Rossville Hexagon® Cologne Spirits are specially fractionated grain spirits, unsurpassed in purity and clarity, free from foreign odors. Available for the *finest* perfumes, colognes and toilet waters at 190 proof, pure or specially denatured. Enduring fidelity of taste and odor assures long shelf life of final product.

Rossville Algrain® Alcohol is a highly refined grain alcohol meeting the most rigid purity standards. Free from foreign odor and flavor. For medicines, perfumes, toilet waters, flavoring extracts. 190 proof, pure or specially denatured.

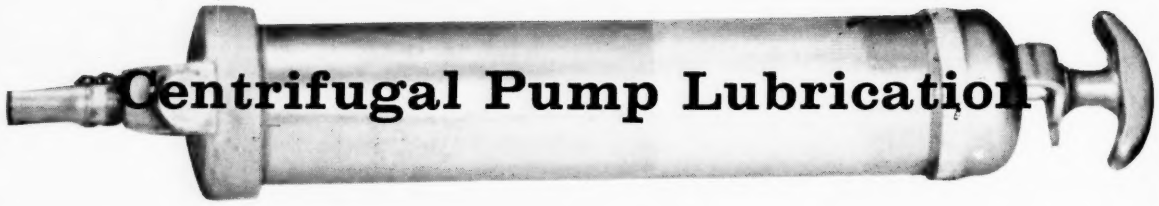
Rossville Gold Shield® Alcohol has uniformly high purity, is free from foreign odor and flavor. For pharmaceutical and cosmetic use. 190 or 200 proof, pure or specially denatured.

CSC also supplies more than 50 authorized specially denatured alcohol formulations and the proprietary solvents, Shellacol®, Quakersol® and Quixol®, as well as Fotocol®, a special industrial solvent.

Only CSC can offer you this unique combination of quality, quantity and choice. Take advantage of CSC service, coast-to-coast. Write for individual data sheets to Commercial Solvents Corporation, Industrial Chemicals Dept., 260 Madison Avenue, New York 16, N. Y.

COMMERCIAL SOLVENTS CORPORATION

METHANOL • METHYLAMINES • ETHYL ALCOHOL • FORMALDEHYDE • BUTYL AND ETHYL ESTERS



Centrifugal Pump Lubrication

Here's a point-by-point comparison of oil- versus grease-lubricated ball bearings, and a guide to efficient lubrication of each.

JOHN H. DOOLIN, *Worthington Corp.*

In recent years, centrifugal pumps have been applied to wider ranges of temperature, pressure and speed than ever before. At the same time, new and better oils and greases have appeared on the scene. These two trends have focused considerable interest on ways of achieving correct and trouble-free lubrication.

In some cases, this interest has been accompanied by certain prejudices concerning the virtues of oil versus grease. Thus a good way to begin this review might be to consider the factors that influence the choice of lubricant.

Below is a list of these factors—the "X" next to each indicates the preferred method. This preference is relative only, and does not mean the other lubricant is totally unsuitable:

Factor	Oil Preferred	Grease Preferred
Design simplicity and cost		X
Flexibility of mounting position		X
Effectiveness of lubricant	X	
High liquid temperature	X	
Low liquid temperature		X
High speed	X	
Protection against contamination		X
Lubrication schedule	X	
Ease of cleaning	X	

The score of five to four in favor of oil is not too meaningful in itself, as one or two considerations will usually predominate in any particular given case.

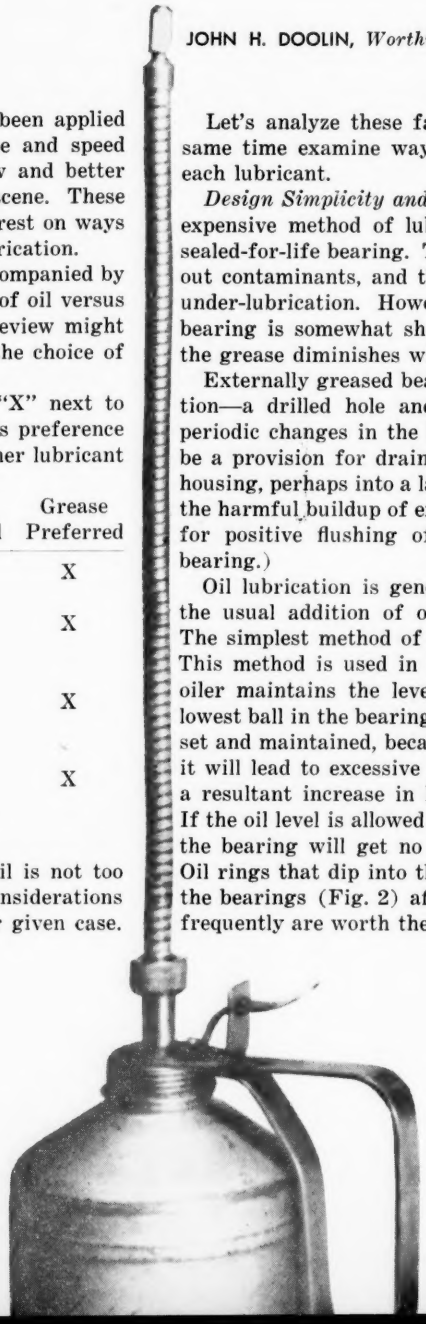
Let's analyze these factors individually and at the same time examine ways of getting the most out of each lubricant.

Design Simplicity and Cost—The simplest and least expensive method of lubrication is the prelubricated sealed-for-life bearing. The seal is effective in keeping out contaminants, and there is no danger of over- or under-lubrication. However, the life of this type of bearing is somewhat short because the usefulness of the grease diminishes with time.

Externally greased bearings do not have this limitation—a drilled hole and grease fitting provides for periodic changes in the lubricant. (There should also be a provision for draining the old grease out of the housing, perhaps into a larger reservoir. This prevents the harmful buildup of excess grease, and also provides for positive flushing of the old grease out of the bearing.)

Oil lubrication is generally more expensive, due to the usual addition of oil slingers and oiler devices. The simplest method of oil lubrication is flood oiling. This method is used in Fig. 1 where a constant-level oiler maintains the level at about the center of the lowest ball in the bearing. The oiler has to be carefully set and maintained, because if the oil level is too high, it will lead to excessive splashing and agitation, with a resultant increase in heat from the added friction. If the oil level is allowed to drop below the bottom ball, the bearing will get no lubrication, and quickly fail. Oil rings that dip into the oil and splash a spray onto the bearings (Fig. 2) afford additional protection and frequently are worth the added cost.

Continued on page 212



THE HILTON DAVIS CHEMICAL COMPANY

DIVISION OF STERLING DRUG COMPANY

HAS NOW FOUND A VALVE THAT SATISFIES THEM

they tried this one then...

THEY BOUGHT	
JANUARY 1960	10
FEBRUARY 1960	30
APRIL 1960	8
JUNE 1960	11
SEPTEMBER 1960	5
OCTOBER 1960	7
NOVEMBER 1960	24
DECEMBER 1960	21
JANUARY 1961	51
FEBRUARY 1961	60
APRIL 1961	10
MAY 1961	20
JUNE 1961	10
AUGUST 1961	20
TOTAL	287

Exhibiting at 28th Chem Show New York City Nov. 7–Dec. 1

DURCO SLEEVELINE® VALVES

THIS NON-LUBRICATED PLUG VALVE SEALS PERFECTLY–CUTS MAINTENANCE

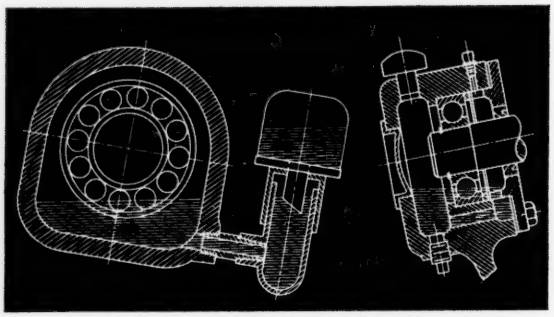
The feed valves to the ball mills in the production of salicylic acid had caused continual problems. This is where the first SLEEVELINE valve was tried. It worked beautifully, and still does. Because they work so well, SLEEVELINE valves are now being used throughout the plant. In fact, they're so well liked they're being stocked.

Try SLEEVELINE valves on *your* toughest problem; before long, you'll probably stock them too.

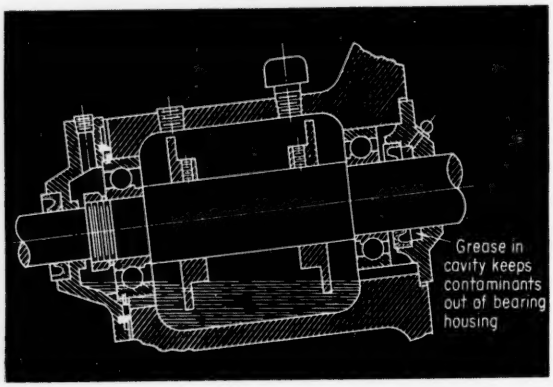
THE DURIRON COMPANY INC., DAYTON, OHIO

SERVES THE PROCESS INDUSTRIES

DURCO



Constant-level oiler on this flood-oiled bearing can maintain oil level, even if pump is mounted at a moderate horizontal angle (left) or vertical angle (right).—(Fig. 1)



Slingers can keep bearings splashed with oil over wide range of oil levels—(Fig. 2)

Mounting Position—Grease offers undisputed advantages where the mounting position is at a sharp angle to the horizontal. In the simpler types of oil lubrication systems, a level must be maintained in a sump or pool of oil. Obviously, a horizontal pump could not maintain such a level when mounted vertically or at an extreme angle, or where the mounting position is constantly changing, such as in a portable unit or a truck-or-ship-mounted unit.

Small angular discrepancies actually cause few difficulties, as the oil level can usually be adjusted accordingly. For instance, in frame-mounted units (where bearings are only on one side of the impeller), ring-oiled bearings provide considerable flexibility in the mounting position and oil level. As long as both rings make contact with the oil, the bearings will stay lubricated, as shown in Fig. 2.

Where the impeller is supported between bearings, each bearing has its own sump, which can easily be controlled if the angle is not too great. The one such bearing shown in Fig. 2 has an adjustable oil reservoir to maintain flexibility.

Effectiveness of Lubricant—Oil is usually more effective than grease, since a good lubricant must form a film between the moving parts and carry away any excess heat. With grease, it is actually the limited amount of oil carried by the grease base that does the lubricating job—the latter is only a vehicle for carrying the oil to the bearing, and so is extra baggage in the final stage.

The grease base also tends to retard circulation of the lubricant and so slows down the rate of heat transfer. With oil lubrication, the film is constantly being changed, and the heat is thus carried away more effectively.

High Liquid Temperature—At elevated liquid temperatures, there may be a tendency for bearings to run hot. Without an external cooling system, bearing temperature follows fairly closely behind liquid temperature. Thus, a unit handling 250 F. water may have bearing temperatures as high as 175-200 F. At such levels, the base of many greases melts and runs off, leaving the bearing without lubrication. With oil, this does not happen and, furthermore, the better heat transfer effect of oil will keep the bearing temperatures down.

To select oil of the proper viscosity, the actual operating temperature of the bearings must be measured or approximated from experience with other pumps. Below is a chart with such approximations, and the recommended oil. The bearing temperature column assumes that there is no auxiliary cooling.

Liquid Temp., °F.	Bearing Temp., °F.	Viscosity, SSU.* at 100 F.	SAE No.
Up to 140	0 to 125	75	5W
141 to 225	126 to 145	150	10W
226 to 400	146 to 180	300	20
401 over	180 to 200	700	30

* SSU. Is Saybolt seconds universal.

Low Liquid Temperature—During operation, bearing temperatures tend to remain above ambient, regardless of how low the liquid temperature goes. In one case, when handling liquid oxygen at minus 300 F, bearing temperatures remained over 100 F.

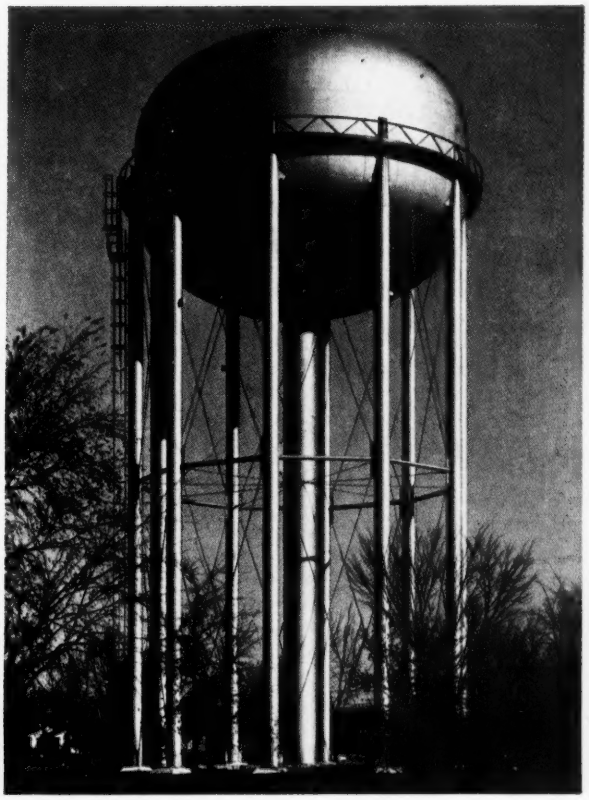
However, when shut down, bearing temperatures quickly drop, and condensation can take place on the bearings. If this cannot be eliminated by space heaters or other means, grease lubrication usually provides the most suitable protection. Grease is more tenacious and will adhere better to the bearing, thereby keeping the condensation off the metal surfaces. Hydrocarbon oils and greases pose something of a fire hazard in the case of liquid oxygen, so that silicone grease is recommended for this service.

High Speed—Since oil is inherently more effective than grease, oil lubrication is frequently a necessity at the higher speeds.

The maximum permissible speed suggested by the bearing manufacturers for grease lubrication is generally from one-half to two-thirds that allowed for oil lubrication. In many cases, this is no problem since the maximum permissible bearing speed is well above the

SILICONE NEWS from Dow Corning

Found: a paint that lasts



Silicone-based paints last longer; reduce maintenance time and costs

These two pictures emphasize the stubborn fight that maintenance coatings based on Dow Corning silicone resins put up against severe weathering conditions. Located in a northern industrial city, this water tower is constantly exposed to an army of paint killers — summer sun, winter sleet, smoke, rain, *plus* a corrosive chemical laden atmosphere.

At left, the tower is shown two years after it was painted with a conventional organic coating that withstood severe weathering during this period. Rust and corrosion marred its appearance and promised even greater damage. Using organic paints it was necessary to paint the tower at least every two years, a costly, almost continuous job.

Now, see how a silicone-based paint has cut this maintenance process in half. At the right, the tower is coated with an aluminum pigmented silicone-alkyd. But this paint job was done two years ago! The tower is still gleaming bright and completely protected. And maintenance men predict it will stay that way for several years more. The savings in time and money are obvious.

Beat high heat! Such a silicone-based coating can also be readily applied to surfaces that run hot, such as encountered on industrial stacks, mufflers, furnaces. Blistering, peeling, rust and corrosion are prevented; need for costly repainting and — in many cases — expensive replacement is greatly reduced.

Lasting colors, too. Silicone-based paints are now available in many colors . . . colors that stay put and don't fade. This means you can carry your color-coding on hot equipment for greater safety and efficiency while improving the overall beauty of your plant.

When you can have coatings like this — that last from 25% to 50% longer; that make plants and equipment look better, longer — don't you think you should find out more about them soon?

Send for your copy of "Why Silicone-Based Paints Mean Less Maintenance". Write Dow Corning Corporation, Department 2422, Midland, Mich.

first in silicones

Dow Corning

pump operating speed. However, for pump speeds greater than 3,600 rpm. and bearings larger than 3-in. I.D., oil lubrication may be necessary. In extreme cases, special oil-mist lubrication or cooling of the oil is called for.

Protection Against Contamination—Grease lubrication is effective in protecting the bearing from contaminants, since the grease forms a static barrier. However, oil lubrication systems can easily incorporate this protection by adding a separate grease-seal cavity outside the oil lube system. Such an arrangement is shown in Fig. 2. This system provides the combined advantages of oil for lubrication and grease for protection.

Lubrication Schedule—The frequency with which bearings must be lubricated could be the determining factor in deciding the best method of lubrication.

The simplest arrangement of all is to avoid periodic lubrication altogether by using prelubricated and sealed bearings. These bearings are packed with grease by the bearing manufacturer, and then protected by a flexible lip seal on both sides. This assurance of clean, lubricated bearings in the unit at all times may be very significant for pumps operating in remote areas of a plant, or in plants that do not have regular maintenance men. However, as previously indicated, the life of such a bearing is limited by the effective life of the small amount of grease initially in the bearing.

Regular grease-lubricated bearings should have grease added every 1,000 to 2,000 hr., depending on both the severity of the service and the surroundings. For pumps operating continuously 24 hr./day, this would be every 6 to 12 wk. For pumps on 8 hr., 5 days/wk., this would be 6 to 12 mo. Pumps on less-frequent or intermittent duty should be greased once each year or two.

Care must be taken to avoid both under- and over-lubrication. While neglected bearings could fail prematurely from contaminated old grease, the too-frequent addition of grease increases the friction in the bearings and could also cause failure. Because the bearing grease is out of sight, this overlubrication can be a real danger unless special reliefs are incorporated in the design.

Oil lubrication is less of a problem, particularly when a constant-level type of oiler is used (see Fig. 1). Here the oil in the reservoir can only come out when the opening to it is above the operating oil level. Air can then get into the reservoir, which allows oil to flow out until the operating level rises to cover the opening again. In doing so, the operating level is maintained practically constant. If the reservoir is transparent, an occasional visual check will show when refilling is needed.

Instead of constant-level oilers, sight-glass oilers are often used. However, if the oil level is critical, (as in flood-oiled bearings), these oilers require more frequent attention in order to maintain the proper level.

Cleaning—Besides the normal addition of grease or oil, a complete change of lubricant and a cleaning of the housing and bearing is necessary in certain environments to obtain maximum life from the bearing.

With grease lubrication, the design must be such that the inlet and drain are on opposite sides of the bearing. A hot light oil can then remove grease and deposits from the bearing. Any remaining oil should be purged with fresh grease before starting.

With oil lubrication, extensive cleaning is seldom necessary, and it is usually sufficient to drain off the old lubricant and add the new.

Types of Oil—Lubricating oils can be classified in many ways, but this discussion will be limited to viscosity, viscosity index, and additives.

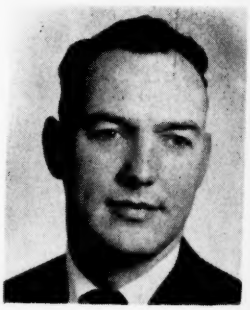
Viscosity is a measure of the shear strength of the oil, or its ability to maintain a film between metal surfaces under load. The higher-viscosity oil can do this better, but it impedes flow, and movement of the parts, to a greater degree. Consequently, there is some optimum viscosity value that will provide adequate lubrication without causing excessive drag on the bearings. This value corresponds to about 75 SSU. at standard conditions, but varies with the temperature of the bearings as previously discussed.

• The Viscosity Index (V.I.) is a measure of how drastically viscosity changes with temperature. Oils of low V.I. show greater changes in viscosity than oils of higher V.I. Pumps that alternate between hot and cold liquids, or frequently start cold and run at high temperatures, operate best with oils of high-viscosity index.

Lubricating oil is available with many additives. For centrifugal pumps, it should have the following:

• Antifoam additives to keep foam from building

Meet the Author



JOHN H. DOOLIN *is product engineer for centrifugal pumps at Worthington Corp.'s Standard Pump Div., at East Orange, N. J. He is responsible for new developments, as well as all engineering aspects of the product line. His previous responsibilities, during his eleven years with Worthington, included five years as a centrifugal pump design engineer.*

He received an M.S. in mechanical engineering from Newark College of Engineering, where he now teaches undergraduate evening courses.

He is a licensed professional engineer, and maintains membership in ASME.

All this, plus five children, doesn't leave him too much time for his favorite hobbies—golf and bowling.

ORONITE®

WHEN THERE WAS NEED FOR AN ADVANCED PRODUCT!

The problem: To help projected manned aircraft and missiles break through the "heat barrier" during hypersonic flight. Hydraulic fluids, which would perform under extreme conditions, were needed to control operation of guidance and weapons systems.

The solution: Oronite developed High Temperature Hydraulic Fluids for the U. S. Air Force and aircraft industry. These fluids perform at temperature ranges of from −65° to +520° F, at pressures exceeding 4000 psi.

Substantial research and cooperative technical service programs are essential to success in developing new, advanced products.

You will find Oronite capable and willing to participate in other major product development programs—to help your company be "first with the future."

Where chemical raw materials are born and produced in volume

CALIFORNIA CHEMICAL COMPANY
ORONITE DIVISION

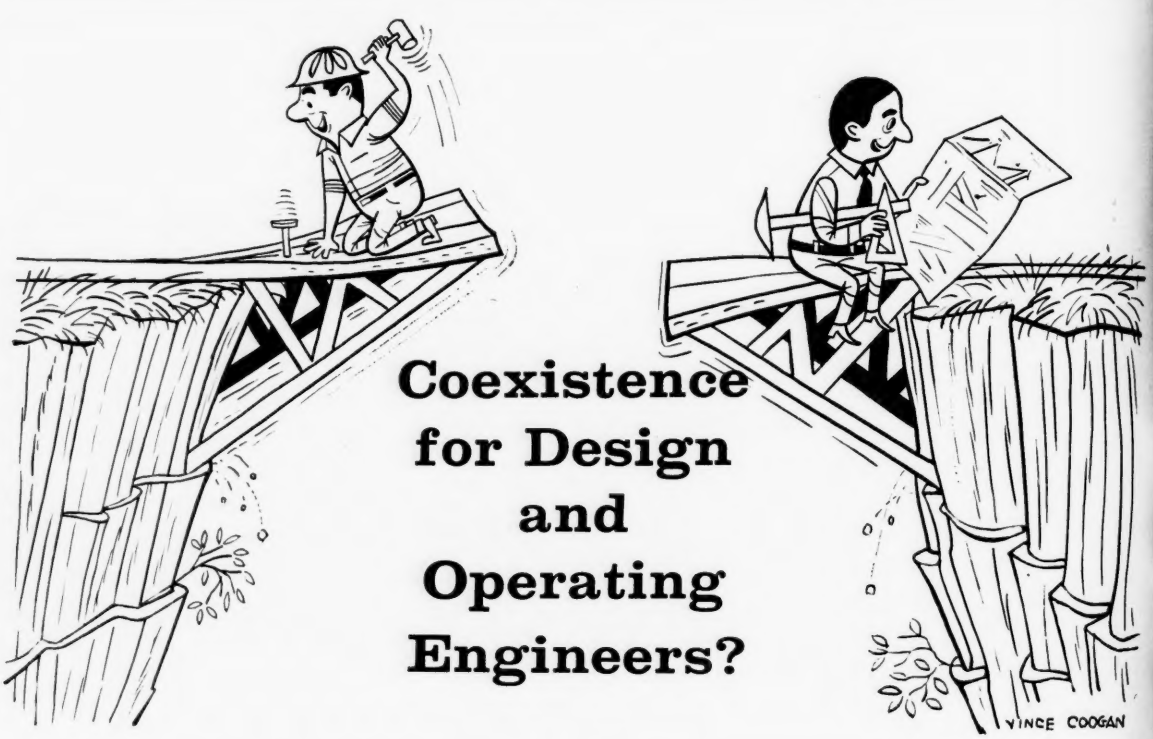
EXECUTIVE OFFICES • 200 Bush Street, San Francisco 20, California
SALES OFFICES • New York, Boston, Wilmington, Chicago, Cincinnati, Cleveland, Houston, Tulsa, Los Angeles, San Francisco, Seattle
FOREIGN AFFILIATE • California Chemical International, Inc., San Francisco, Geneva, Panama, Sao Paulo

7033

up in the oil sump and clogging the lubrication system.

- Rust inhibitors to protect metal parts against corrosion.
- Antioxidation additives to prevent formation of gums in the oil.
- Detergents, if convenient, to keep the system clean.

Type of Grease—Grease is a mixture of lubricating oil and a soap base that keeps the oil in suspension. Classification is usually according to the soap base material, consistency and additives. For pump bearings, a moisture-resistant grease of No. 2 consistency that contains a rust inhibitor is recommended. For bearing temperatures up to about 150 F., the base should be lime; for temperatures over 150 F., it should be lithium.



Coexistence for Design and Operating Engineers?

The chasm between process designers and operating men has deepened, and poor lines of communication make cultural exchanges difficult. While Esperanto may be dead, there's much to be said for learning the other guy's language.

WINGATE H. RICHARDSON, *Consultant, New York*

In the early days of radio, there was a very popular program called "The Two Black Crows" that was similar to the Amos and Andy series that came along later. One of the programs put on by the Crows started out something like this:

"I was reading in the paper today that these here scientists have measured the distance to the moon, and they say it's 239,000 miles away. How you suppose they do that? A man can't walk out there with a tape measure."

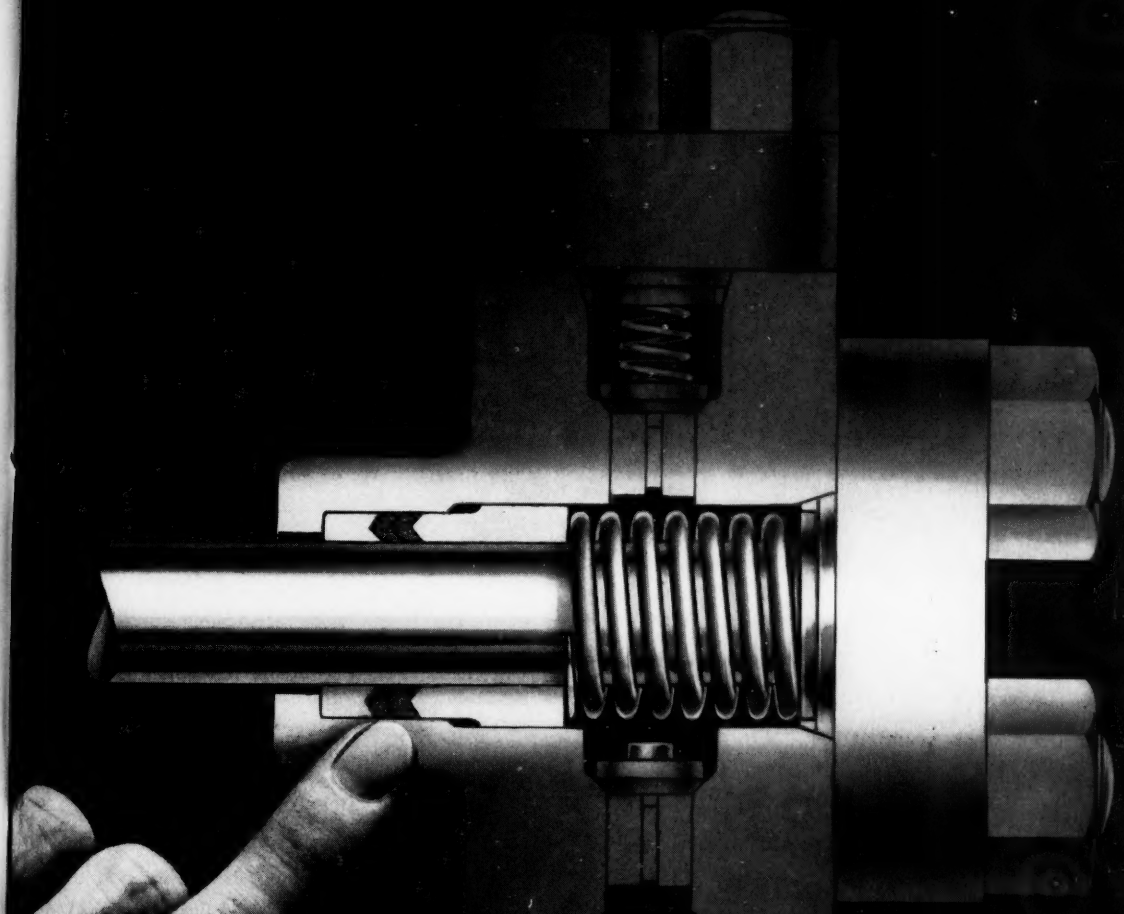
"Shoo! Don't you know how they do that?"

"No, how?"

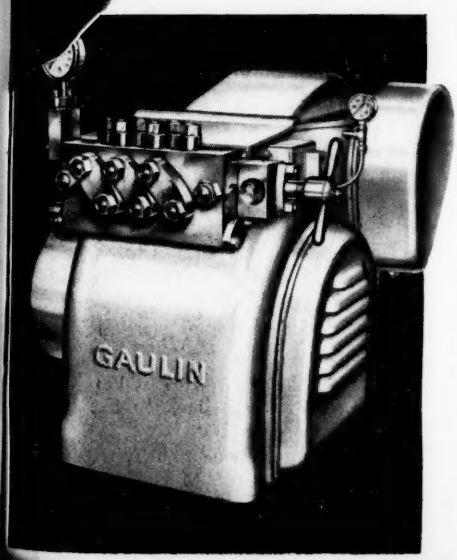
"Well, they guesses half the distance; and then, they multiplies it by two."

Today, our scientific and professional journals are filled with the feats being accomplished by electronic computation. Enthusiasm for this new discipline has grown so great that many of our engineering schools are rapidly altering their undergraduate curricula to include additional emphasis on advanced mathematics. This would be all to the good, if it were possible to add such courses without abandoning others. Unfortunately, this is not possible; and the courses being deleted are those that might be described as training in "the practice of the art."

When one examines thoughtfully the shaky foundations, the basic assumptions upon which many of our complex engineering calculations are based, one (at



3 million cycles without a leak
AT 3000 PSI



GAULIN TRIPLEX PUMPS

Save "Packing" Failure at High Pressures

Less wear. Even at pressures of 3000 PSI, 2 or 3 Gaulin packing rings *last many times longer* than 7 or 9 rings on other pump designs. Because a Gaulin packing *acts as a seal not a bearing.*

Quick change. It takes less than 15 minutes to change a Gaulin packing, where other makes require up to half a day.

Set and forget. Gaulin's exclusive automatic packing adjustment eliminates human error. Assures uniform packing tension.

No product contact. Equipped with Gaulin's exclusive purge system (not shown above) Gaulin packing is isolated from the product. No part of the plunger contacting the product ever touches the packing. With this system, a Gaulin moves "pressure sensitive", "abrasive", and "toxic" materials at minimum cost — without breakdown or excessive wear.

120 different cylinder designs available to meet every product problem. Capacities from 50 to 7500 GPH...pressures from 500 to 12,000 PSI. *See your Chemical Engineering Catalog for the name of your local Gaulin representative.*

MANTON-
Gaulin
MANUFACTURING CO., INC.
71 Garden Street, Everett 49, Mass.

least this one) gets an uneasy feeling that we are "guessing half the distance and multiplying by two."

Look Ma, I'm a Designer

During the early days of my career, I accepted a position with an engineering firm to do process development and design. I started off with full enthusiasm and designed a distillation system—first, of course, making the necessary "basic assumptions." When this was completed, I expected to have the design translated into pilot plant equipment for the purpose of checking by actual operation the validity of my design and particularly of my assumptions.

However, this did not happen. It was decided that we should make a new set of assumptions and a new design. When this continued through a series of nine designs, I slowly came to the realization that this was "process development and design" in its entirety. I was rather unhappy, because I felt the proof of a design was in the operation.

My point of view was not generally shared by my colleagues. In fact, I was definitely a minority. I seldom won any arguments about design problems, since my strongest feelings always centered on the question "How are you going to operate it?" The usual answer was "That's not our problem. Let the operators worry about it."

So, of course, this job and I soon parted company.

When Is a Yield not a Yield?

I must admit I was somewhat shaken by my experience with design and development. I secured a new position, this time with an operating company, and soon found myself fully occupied with the multitude of problems involved in starting up a new plant. Distillation operations were my main concern.

One of our processes involved removing unused reactant from a reaction mixture. This was accomplished in three towers. The first gave us a 50% overhead, which was then concentrated to 99% or better in a second column. The bottoms from the first tower contained the product and about 2% unreacted material, which was stripped out in a third tower. From time to time, we attempted to increase the concentration of the unreacted material, in the overhead from the first tower, to 60% or 70%, but we always ran into trouble.

After some thought, I requested permission to alter and supplement the control system on the first tower. The result was that we were soon able to increase the unreacted material taken from the overhead to better than 99%. We were now losing so little out the bottom that we were able to discontinue the operation of the two extra towers. Everyone was happy. The word went back to the home office and, of course, to the engineering department.

So we had a visit from the engineers—the ivory tower boys, that is:

"Wingate," they said, "we hear that you have altered the design on the distillation section and that you are removing all the unused reactant in the first tower."

"That's right."

"Well now, that's impossible. We have gone all over our design calculations very carefully and can prove it won't work."

They unrolled their diagrams, went into a lengthly discussion of "operating lines," etc., and wound up with:

"So you can see it is impossible."

"Well, now, I'll tell you what you do. You go out in the plant and look at it. We've been operating this way for about two months."

"You are confused. You are not getting the results you think you are."

"Well, why don't you go out there and measure the feed tanks and receivers, take samples, have them analyzed, and then when you have some real information, you can show me where I am confused."

I admit I was feeling pretty good. After my experience in arguing design theory with the design boys and always losing the argument, it was nice to have a going operation to back up my statements.

Weeks followed while the design department investigated my "impossible operations." And almost every night I got the same report.

"We admit that all of the facts indicate that the tower is operating as you say it is—but we know this is impossible."

Then came the happy day. They came in, all smiles.

"Say, we found out how you can operate that tower so it will do what you have been claiming it does. You assume a fictitious molecular weight for the unreacted material and redraw the equilibrium diagrams. Then the operating lines show that there are enough plates in the tower to effect the separation."

Their parting advice was:

"You don't have to worry about it any more. It will work all right just as it is."

Inasmuch as we had been operating this way for several months and I hadn't "worried about it" after the first 24 hours, I thought their advice a little unnecessary.

When I think about the importance of the basic assumptions, I wonder if an analog computer would have come up with that fictitious molecular weight in time to get the initial design right.

A Plea for Better Communications

Much could be gained by strengthening the lines of communication between operating and design personnel. Unfortunately, the present trend seems to be in the other direction.

When I left college, those of us that wanted to go into design and construction went to work on the drafting board. After a reasonable apprenticeship—one or two years—we were sent out on a construction job in minor supervisory or inspection positions; and we stayed to assist in start-up operations. Then if we wanted to get into design, it was back to the home office.

In those days, actual experience with fabrication,

New VARSOL®
For Long Lasting Sweetness!

"Why the enthusiasm? Because users of new, improved Varsol find that it keeps its long lasting sweetness after numerous processings or long storage periods. A unique hydrofining process, developed by Esso Research, makes possible this major solvent development. Quality controlled Varsol, like all Esso solvents, reaches your plant fresh, uniform and on schedule from modern, conveniently located storage terminals. For further information or expert technical assistance call your Esso Representative or write to us at 15 West 51st St., N.Y. 19, N.Y. (And tell 'em Nosey sent you!)" *Nosey*

HUMBLE OIL & REFINING COMPANY Esso

construction and operation was an absolute prerequisite for a career in design. I think that it was a good system. Today, many engineers in design have not only never operated the equipment they design, in many cases they have never even seen it in operation.

Perhaps the present trend of engineers towards early specialization has lead to a weakening of our lines of communication. Perhaps these lines have always been weak.

Many years ago, a paper on distillation was presented at a technical society meeting. During the discussion following presentation of the paper, one speaker from the floor made the following comment:

"I have listened carefully to this paper; and although I have had considerable operating experience in the field of distillation, I find that I can understand very little of what the author has presented here. I do know this: if I keep the bottoms of my towers hot and the tops cool, I can operate my towers satisfactorily."

At a very recent technical meeting, a different speaker presented the other side of the picture:

"Let's face it, gentlemen. We design our plants, supervise their construction, and then we turn them over to the type of engineer that eats his lunch out of a tin box and pray that we do not have to go back and run the plant ourselves."

Even if you are the "type of engineer that eats his lunch out of a tin box," it will pay you to learn to speak the language of the engineering division.

Talk Their Language and They'll Listen

We were operating a vapor-phase catalytic reaction. The products of the reaction were condensed in a series of water-cooled and refrigerated condensers. Tarry residues caused fouling of condenser surfaces, necessitating frequent cleaning operations.

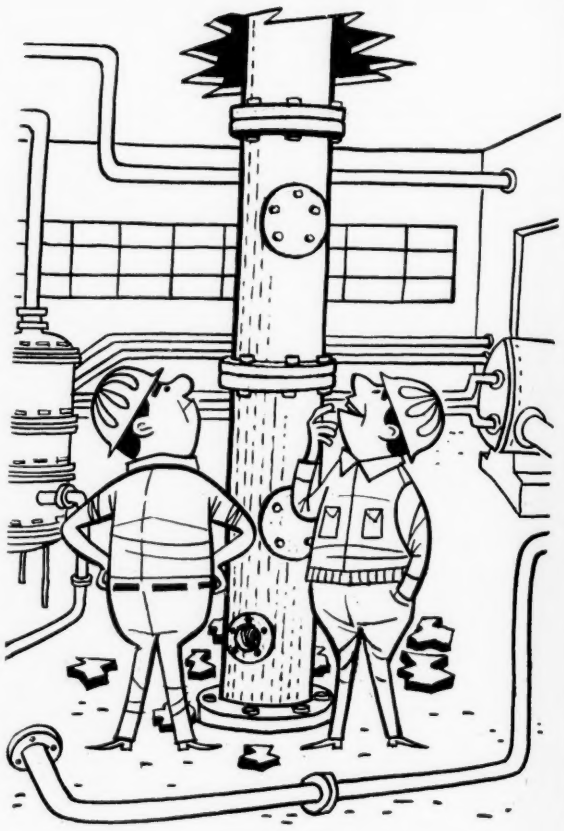
We came up with the idea of using a scrubbing tower to remove and cool the tars and bottom product, followed by a condenser for the now-clean overhead solvent. So heigh-ho and away we go to the engineering department to get the tower designed. (We had our own design, but of course didn't mention this.)

We submitted all pertinent data and sat back to wait for the design. In due time, we had it—a tower only 10 in. in dia. but 28 ft. high. Well, this wasn't exactly what we had in mind, but experience had taught us the futility of arguing the merits of a design with the design group. So we said "Thanks a lot" and allowed a respectable period of time to elapse. Then we made our next move:

"You know, we have been thinking about that scrubbing tower. If we replace our converter, we could use a new one with four times the capacity. We'd better redesign the scrubbing tower to allow for this, or else it might become a bottleneck."

In a few weeks, we got the new design, and with one more "adjustment" of our estimated capacity we had what we wanted.

One other change was necessary. We insisted that 22 ft. would be an adequate height. When they pinned us down on this, we admitted that we had "calculated" the height by the simple procedure of measuring the distance between floor and roof, and this was the maximum height that we could install.



"Do you think the people upstairs will mind?"

I wouldn't recommend designing a petroleum refinery on this basis, but it was a satisfactory procedure for the scale of our operations. The tower worked very well. The overhead ran much colder than expected; and at the first shutdown period, we removed two sections from the top of the tower.

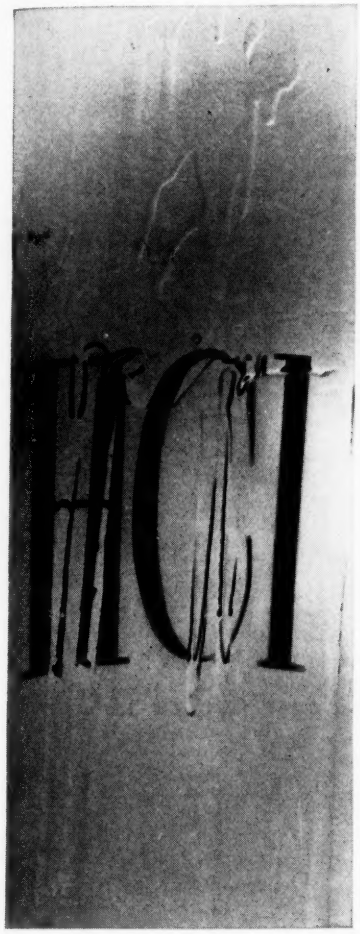
So if you learn to speak the proper "design" language, you can get what you want for your operations.

This is the ninth in a series of articles on practical operations by an experienced operating man. Previous articles:

Temperature Control	**Sept. 21, 1959**
Inventory Cheating	**Nov. 30, 1959**
Specifications	**Feb. 8, 1960**
Salesmen	**May 2, 1960**
Safety	**July 11, 1960**
Stealing	**Oct. 17, 1960**
Manufacturing	**Jan. 9, 1961**
Departmental Costs	**May 29, 1961**

BRIEFS

On muriatic acid solutions
Top-quality phenol
Extra-pure phosphorus trichloride



FAST WAY TO DILUTE MURIATIC ACID

You can probably save yourself some time by sending for our muriatic acid data sheet.

A quick look at the dilution table it contains tells you how much of the acid you need to make up solutions of various strengths.

The same sheet gives you good advice on safe handling of muriatic acid and lists our specifications.

A glance at these specs shows you how extremely pure our product is. "Hooker White" grade, completely free of arsenic and free chlorine, contains no more than 0.0001% iron, a maximum of 0.003% sulfates and 0.0002% maximum organic matter.

The commercial grade, nearly as pure, contains 0.0005% iron at most, a trace of free chlorine, 0.003% sulfates, not over 0.001% organic matter, and no arsenic.

Check the coupon for data sheet.

HIGH-QUALITY PHENOL

Typically assaying over 99.5% by bromination, our phenol has more than purity to please you.

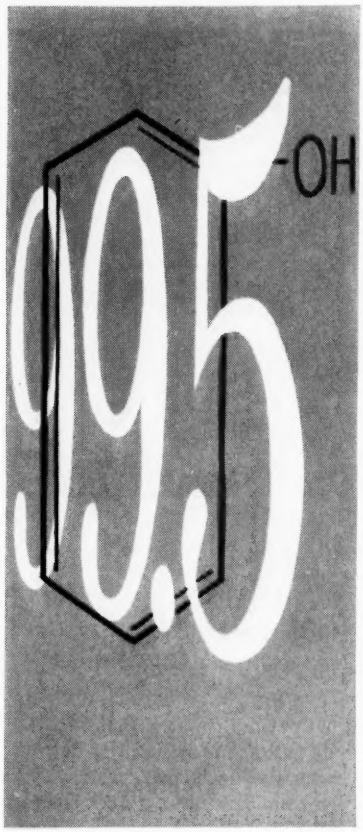
It has a freezing point of 40.6°C. minimum.

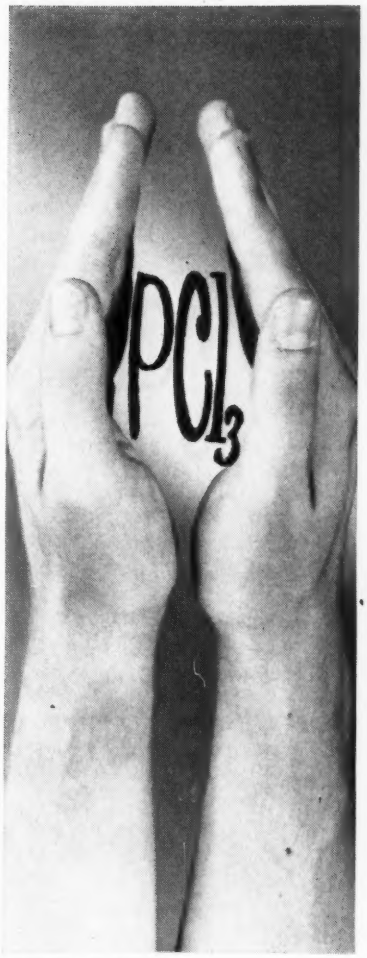
Its distillation range is only 2° from first drop (180°C.) to dryness.

Its color is 20 A.P.H.A. maximum at time of shipment.

Hooker phenol meets or exceeds the requirements of U.S. Pharmacopoeia XV.

Our data sheet gives all the specs. Just check the coupon.





EXTRA-PURE PCl_3 AT NO EXTRA COST

Why settle for less?

Our phosphorus trichloride is a water-white liquid that typically assays 99.9%. It has no free phosphorus, no turbidity.

It distills 97% between 74.5 to 78.0°C.

Use it as a chlorinating agent in making organic acid chlorides, as a condensing agent in preparing organic aldehydes, and as a catalyst in certain chlorination reactions.

For technical data sheet, just check and mail the coupon. For information on PCl_3 and other Hooker chlorinating agents, check the coupon for Bulletin 328-B.

For more information, check here and mail with name, title and company address.

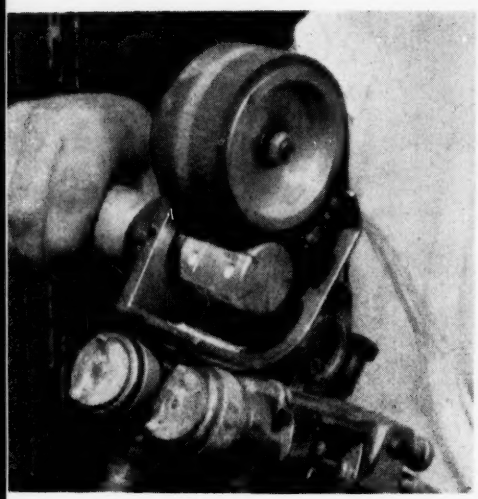
☐ Muriatic acid ☐ Phosphorus trichloride
☐ Phenol ☐ Bulletin 328-B

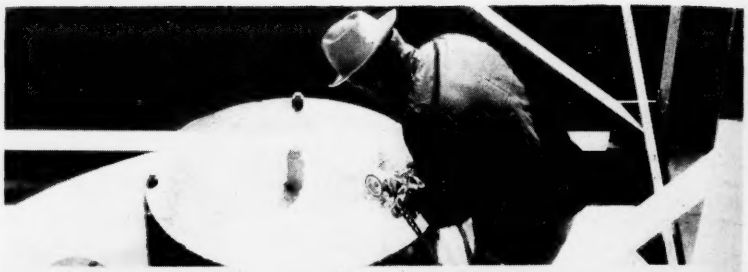
For the complete line of Hooker chemicals, see Chemical Materials Catalog or Chemical Week Buyers' Guide.

HOOKER CHEMICAL CORPORATION
410-1 Forty-seventh Street, Niagara Falls, N. Y.

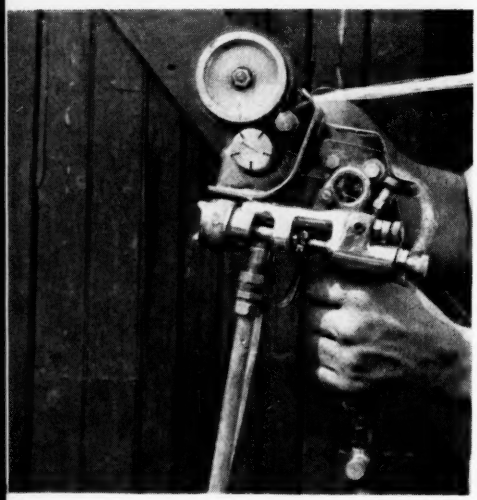
Sales Offices: Buffalo Chicago Detroit Los Angeles New York Niagara Falls Philadelphia Tacoma Worcester, Mass.
In Canada: Hooker Chemicals Limited, North Vancouver, B. C.

HOOKER CHEMICALS PLASTICS





Details of chopper spray gun with a view of its use in coating a chlorine dioxide reactor.



Spray Both Plastic And Reinforcement

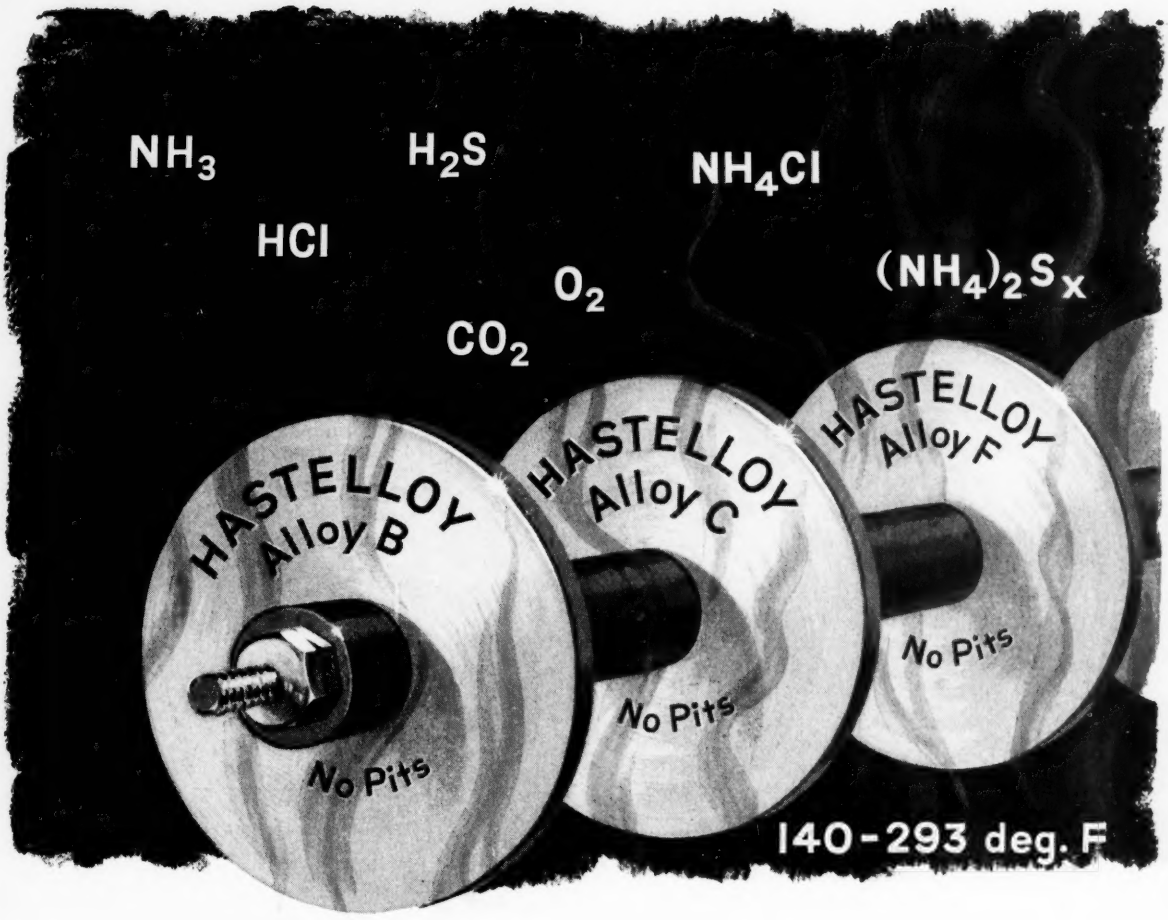
Novel spray gun chops up glass fibers and combines them with sprayed-on plastics, in single operation.

Coating with glass-fiber-reinforced plastic is nothing new, but a recently developed process sprays on the reinforcing fibers together with the plastic itself.

The main advantages of the new technique are speed and ease of application, particularly on chemical equipment having surfaces studded with projections such as nozzles, manholes, sight glasses, wells and the like.

Special equipment required for the work was developed by Chemical Fire and Rust Proofing Corp. (CFR Corp.), Great Neck, L. I., N. Y. The idea of spraying a reinforced plastic appears to have originated with the manufacturers of plastic boat hulls. The CFR Corp. has adapted the technology and equipment to the needs of the chemical industry.

▶ **Special Spray Gun**—Basic to the new process is a newly developed "chopper" spray gun. Shown on p. 224 the gun consists of two conventional side-by-side spray nozzles surmounted by the special glass-fiber feeding and chopping device. Glass threads are fed into the gun in the form of a continuous roving that is pulled along by the large rubber wheel atop the gun. The roving is cut into short (¼-½ in.) pieces by blades projecting from



Pitting Corrosion a Problem?

...Test **HAYNES** Alloys

No pitting from chlorides . . . and less than 1 mil per year penetration . . . on HASTELLOY alloys B, C, and F! These were the results of on-stream tests at six locations in the low-temperature zone of a hydrocarbon bubble tower.

Yet ten other alloys tested showed extensive pitting . . . and corrosion rates up to 15 mils.

Send for test samples

Have you perplexing corrosion problems in your processing equipment? To help you solve them, we have been testing, developing, and perfecting corrosion-resistant alloys for thirty years. We'll gladly send you free samples of HAYNES alloys for you to test yourself.

To be sure you receive the alloys most suited to your needs, please send us as much data as possible about the corrosion problem involved. Ask for a copy of our booklet on HASTELLOY alloys. Write us at 270 Park Avenue, New York 17, N. Y.

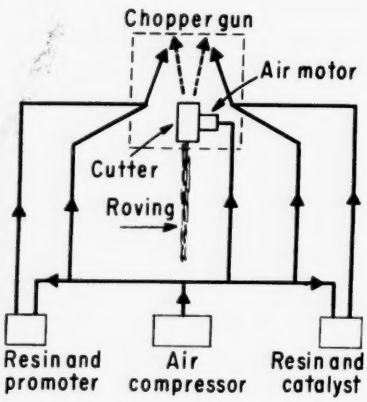
HAYNES ALLOYS

HAYNES STELLITE COMPANY

Division of Union Carbide Corporation
Kokomo, Indiana

UNION CARBIDE

"Haynes," "Hastelloy," and "Union Carbide" are registered trade marks of Union Carbide Corporation.



Schematic diagram of chopper gun.

the periphery of the metal cylinder directly below the rubber drive wheel.

The short strands of fiber are blown into the spray coming from the two nozzles; the three streams meet some two to three inches in front of the nozzles.

▶**Coating Procedure**—In laying down a protective coating on a piece of chemical equipment, the first step is to prepare the metal surface—usually by sand blasting. After the metal is cleaned, the surface is coated with a layer of plastic. A second coating is then laid down that incorporates the pieces of chopped fiber glass. This layer may be built up to any desired thickness. At this point, the surface of the plastic is "furry," since many of the short glass fibers are projecting above the surface. An ordinary felt paint-roller, dipped in solvent, flattens down these pieces, leaving the surface relatively smooth. Application of a finish coat of plastic (without fiber) completes the coating. The final coat may be colored if desired for either aesthetic reasons or for purposes of color coding.

The photographs show the application of a protective coating to three large chlorine dioxide reactors, recently added by Bowaters Carolina Corp. to its Catawba, N. C. paper mill. The chlorine dioxide solution, used in papermaking, is relatively dilute, but nevertheless highly corrosive.

▶**Resin Used**—Based on successful experience at several Canadian mills, CFR Corp. chose a bisphenol A polyester resin, Atlec 382, made by Atlas Chemical Industries, Inc. (formerly Atlas Powder Co.).

As can be seen from the diagram at left resin application is by the so-called two-pot system. In this technique, polyester resin and catalyst (in this case, benzoyl peroxide) are sprayed from one nozzle, and resin and promoter (dimethylaniline) from the other nozzle.

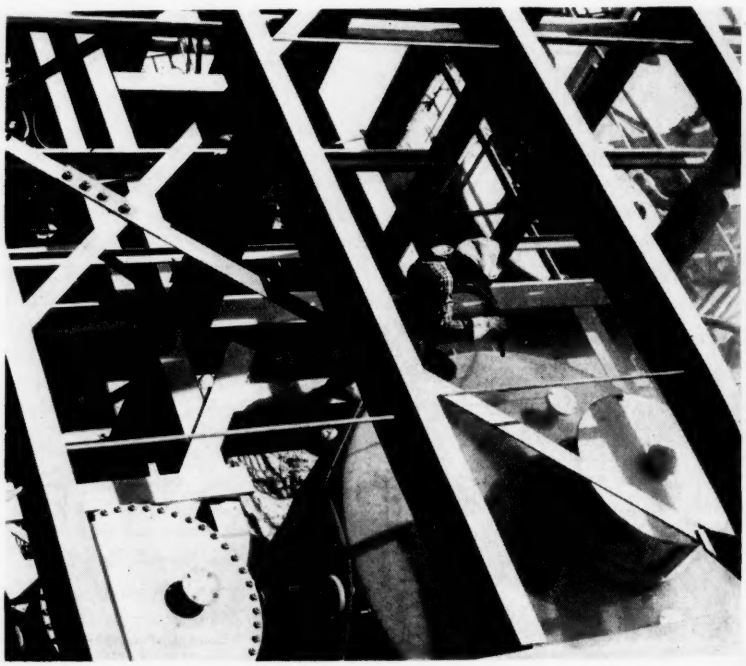
A life of at least ten years has been predicted for the coating. This estimate is based on long-term immersion tests at elevated temperatures.

▶**Economics**—Kurt A. Gruber, president of CFR Corp., claims that the spray method is far more economical than conventional layup methods of making reinforced-plastic coatings, wherein a resin-saturated glass fabric is applied by hand to reinforce the coating. On the Bowaters project, the spraying technique cut approximately 50% from the time that would have been required using hand layup methods. Greatest savings occur when coating highly irregular pieces of equipment where hand layup is particularly time-consuming. In addition, areas inaccessible to hand methods may often be covered by spraying.

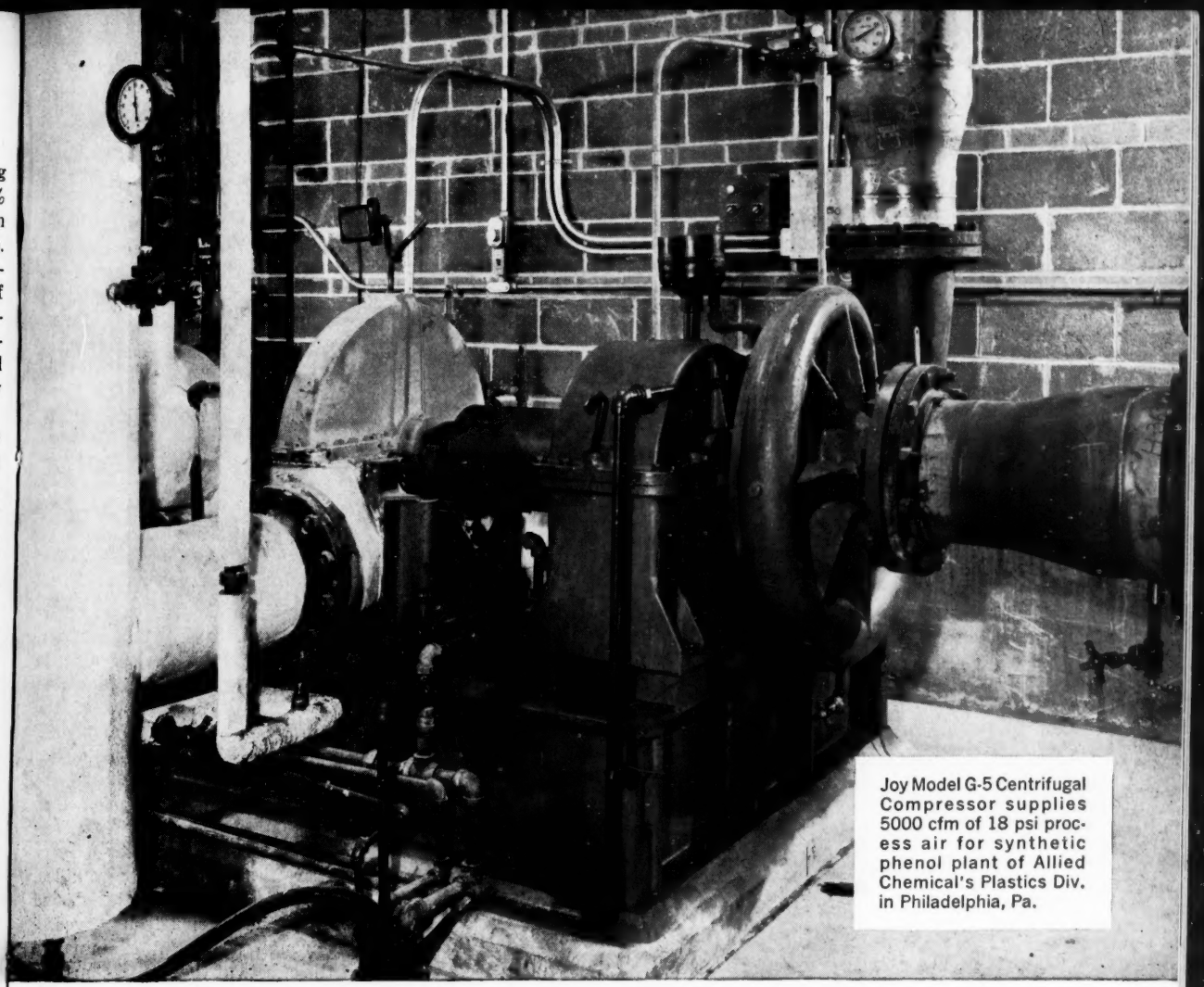
▶**Uniformity**—Another advantage claimed for the sprayed-on coating is its homogeneity which, it is said, provides greater resistance to corrosion. Uniform coat thicknesses, ranging from $\frac{1}{16}$ to $\frac{1}{8}$-in. are easier to obtain by spray techniques than by conventional methods.

▶**Spray Other Materials**—In addition to polyesters, reinforced epoxies and urethanes may also be sprayed. K. A. Gruber states that considerable success has been achieved in spraying reinforced elastomers such as Neoprene and Hypalon. CFR uses the trade name "Elast-o-glas" for all sprayed-on glass-reinforced coatings.

In addition to equipment coating, CFR also will sell the special chopper spray guns to firms that wish to do their own coating.



Sand blasting to clean tank, preparing surface for application of coating.



Joy Model G-5 Centrifugal Compressor supplies 5000 cfm of 18 psi process air for synthetic phenol plant of Allied Chemical's Plastics Div. in Philadelphia, Pa.

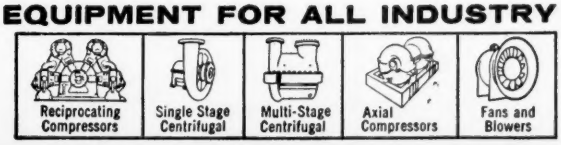
JOY Model G-5 Centrifugal Compressor Supplies 18 psi Process Air at Allied Chemical

Flexibility in meeting instantaneous changes in volumes, plus high efficiency over a considerable range has made the Joy Model G-5 Centrifugal Compressor ideal for Allied Chemical's synthetic phenol plant. The single-stage Model G-5 provides 5000 cfm of 18 psi oil-free air for the oxidation of cumene on an around-the-clock basis.

Joy Model G Centrifugals can provide up to 20 psi air with a single stage. Coupled with their ability to maintain efficiency over a wide range of output volumes, this makes them very economical for many process applications. Use of an integral gear box makes the Model G machines both compact and efficient, and eliminates the maintenance problem which a high speed coupling represents. Compressor and drive are mounted on a single base plate for further space savings.

Model G compressors are available up to 15,000 cfm. Other Joy Centrifugal, Axial and Reciprocating compressors are available in sizes from 15 to 15,000 hp to handle any air or gas compressing requirement. For full information on the Model G, write for Bulletin 3229-11. 3229

AIR MOVING EQUIPMENT FOR ALL INDUSTRY



JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

INDUSTRIAL ATM. - 31 MOS - 4.5 MILS
NO CTG. STD GALV. 0.05 0.08 MG
FLOWING SEAWATER 18 MOS - 1.5 MILS
STD GALV. 0.024 MG 0.084 MG
IND ATM. - 18 MOS.
NO CTG.
0.02 0.08 MG
INDUSTRIAL ATM. - 9 MOS. - 1.5 MILS
STD GALV. 0.024 MG 0.084 MG
STD GALV
0.084 MG
IND ATM.
STD GALV.
UNEXPOSED

Results of corrosion tests are pointed out by Dow's C. F. Schreiber.

MAGNESIUM IN GALVANIZING-ZINC IMPROVES CORROSION RESISTANCE

Magnesium, added to the zinc used for hot-dip galvanizing, improves the corrosion resistance of the resulting coating, particularly in industrial-marine environments.

This information is based on tests made by Dow Chemical Co., and presented to zinc producers at a symposium conducted by Dow at Freeport, Tex.

A practical galvanizing demonstration was made by John A. Heath of Dow's Metal Cleaning Dept. He showed how ingot magnesium could be added directly to the galvanizing bath, and also how similar results could be obtained by adding a zinc-magnesium alloy.

▶**How Much Magnesium?**—Heath stated, "We think that the use of an alloy containing 97% prime western zinc and 3% magnesium offers the most practical method of obtaining improved corrosion protection. The alloy simplifies the process because of the ease with which it can be added to the bath. All that is necessary is to put it in and let it melt."

▶**Improved Resistance** — Data gathered by Dow, which has been evaluating the magnesium additive for six year, indicate that 20 to 90% improved corrosion protection in industrial-marine environments results from a magnesium concentration of 0.03 to 0.05% in the galvanizing bath. In addition to magnesium, Dow has also been testing combinations of magnesium and aluminum, added to the zinc bath. Dow's testing indicates that the most attractive coatings are produced with a magnesium concentration of 0.03 to 0.05%, and an aluminum concentration of 0.003 to 0.005%.

It was stressed during the symposium that better corrosion protection was the overriding objective in the six-year program. This was sought primarily for Dow's own galvanizing, but the zinc-magnesium process has attracted wide industrial interest because of the drastic improvements possible.

Scorched Paint Now "Logs" Fire Temperatures

After a disastrous fire on a partially completed aircraft carrier, naval investigators were able to determine degree of temperatures reached in various parts of the ship by examinations of materials, particularly zinc chromate paint.

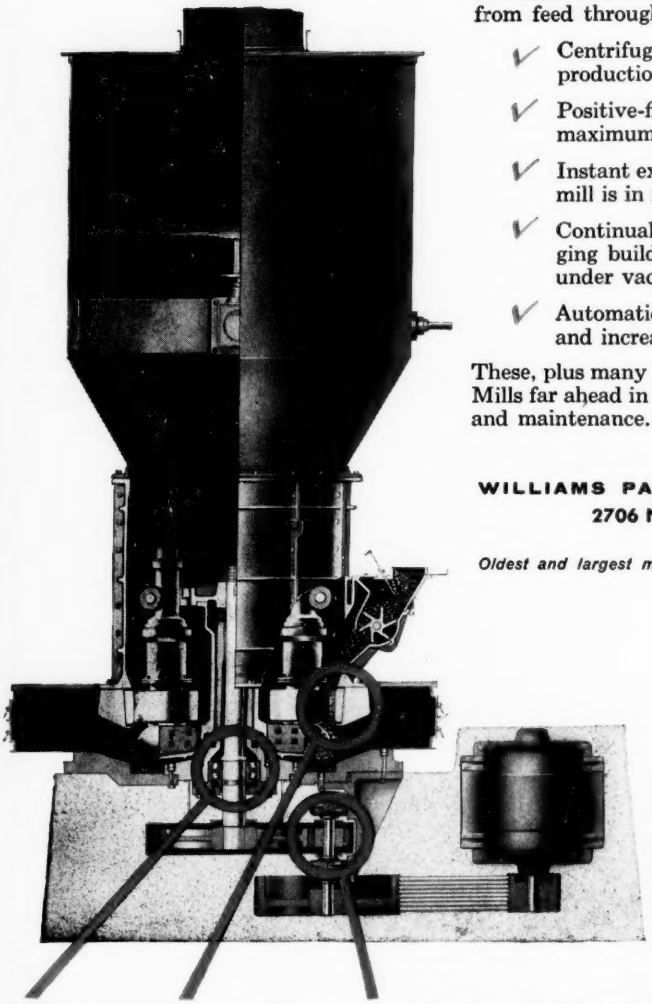
The fire took place aboard the aircraft carrier *Constellation*, then under construction in the New York Naval Shipyard (Brooklyn Navy Yard). Fifty workmen were killed, several hundred were injured, and the ship was seriously damaged.

Through a careful examination of the effects of the fire on construction materials and paint in different parts of the ship, investigators were able to determine the location of the hottest flames. For example, disintegration of thin aluminum bulkheads showed that temperatures in that area must have been at least 1,100 F.

▶**Paint Shows Temperatures**—Some accurate estimates of temperature reached were based on evaluations of the condition of zinc chromate paint, normally used by the Navy for corrosion protection of bulkheads, piping and machinery. The following table shows the correlation between temperature and paint condition:

Zinc Chromate Paint Condition	Temp. °F.
Blistered but clinging tightly.	200-250
Blistered, 50% can be wiped off by hand.	300-400
Can be wiped off by hand.	500-600
Stripped clean.	over 600

Higher output on FINE GRINDING..20 to 400 mesh.. with WILLIAMS ROLLER MILLS



A Williams does the entire job in a single continuous operation—from feed through grinding, blending, drying and classifying!

- ✓ Centrifugal grinding roll action against bull ring keeps production high—automatically compensates for wear
- ✓ Positive-flow feed control is self-adjusting—maintains maximum capacity of mill
- ✓ Instant external fineness adjustment can be made while mill is in motion
- ✓ Continual upward air sweep to classifier prevents clogging build-up of finely ground material. Mill operates under vacuum to insure dustless operation.
- ✓ Automatically controlled hot air is available for drying and increased output of moist material.

These, plus many other advanced features keep Williams Roller Mills far ahead in higher production, lower costs. less downtime and maintenance. *Write for catalog.*

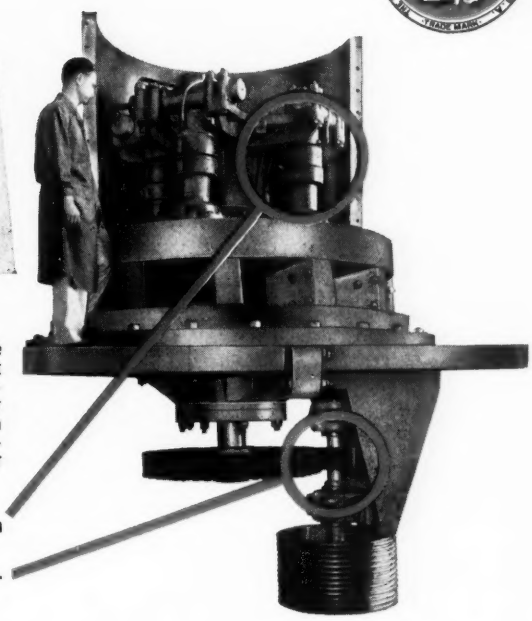
WILLIAMS PATENT CRUSHER & PULVERIZER CO.
2706 North 9th Street • St. Louis 6, Mo.

Oldest and largest manufacturers of hammer mills in the world

Troublesome alignment is greatly simplified and far less frequent with only 2 bearings on main shaft; the bottom one carrying both radial and thrust loads.

From here, material pulverized by rollers against bull ring are airlifted to classifier which passes correctly sized product and returns coarse material for regrinding.

Exclusive! Only Williams has longer-life SPUR GEAR or GEARLESS DRIVES that eliminate expensive bevel and other hard-to-maintain gears. Standard and larger models have rugged spur gear and pinion drive—smaller models have direct motor-to-shaft V-belt drive requiring no care or lubrication.

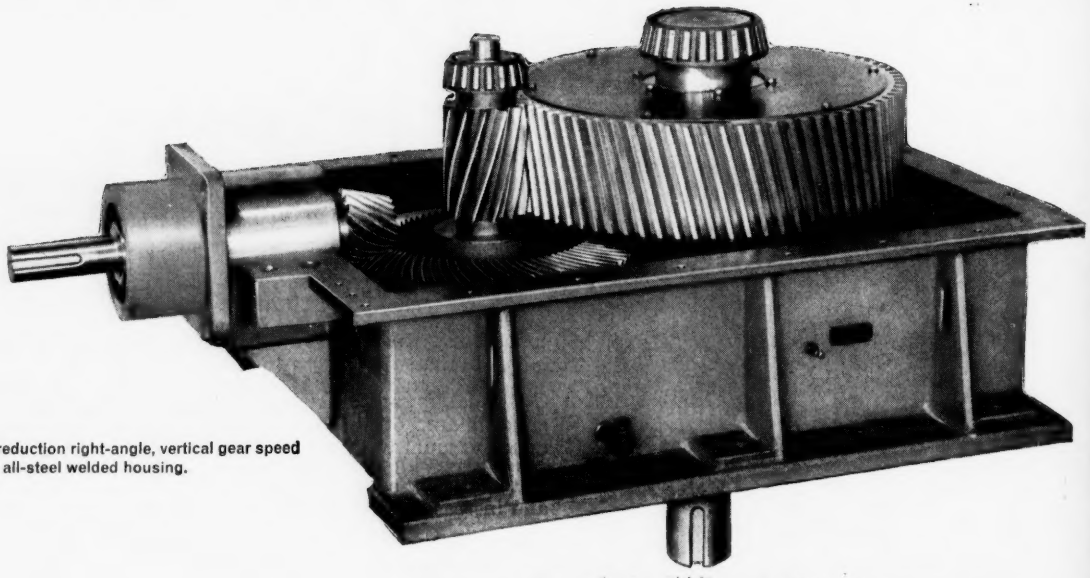


"Giant" mill with cover section off show roller journals which suspend grinding rolls on bearings sealed against dirt and grit. Note wear-resistant steel forged bull ring.

Housing is also removed to show rugged spur gear and pinion drive. Easy, quick accessibility for service is another Williams time and money-saving feature.

WILLIAMS
CRUSHERS GRINDERS SHREDDERS

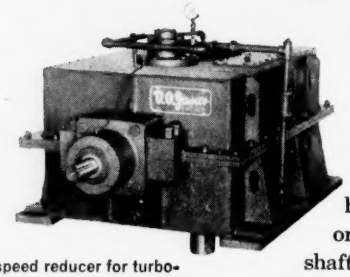
Hammer Mills | Helix-Seal Mills | Air Separators | Vibrating Screens | Feeders | Impactors



Double-reduction right-angle, vertical gear speed reducer; all-steel welded housing.

for high efficiency

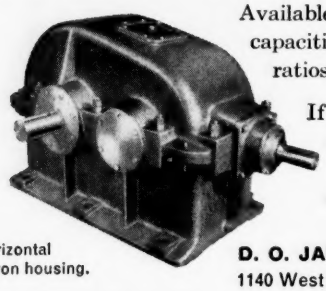
on heavy drive applications... spiral bevel-helical reducers



Right-angle vertical gear speed reducer for turbo-mixer. Capacity: 75 hp at 1750 rpm input, 67.6 rpm output.

You begin earning a *quick return on your investment* in D. O. James spiral bevel-helical gear speed reducers just as soon as you match them to heavy or shock loads, right-angle drive requirements, or applications which demand high reduction ratios. Costsaving forces at work include: over-all efficiency in a range up to 98% . . . capacity to transmit heavy loads smoothly and quietly . . . and housings of cast iron or welded steel — each with the rigidity required to maintain shaft alignment and prolong bearing life. Dry-well construction permits positive oil sealing.

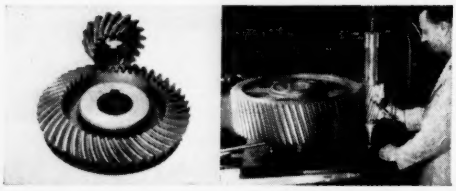
Available in 42 standard sizes — horizontal or vertical design: capacities from 2 to 367 hp; single, double, and triple-reduction ratios from 6:1 to 358:1. (Ask for Catalog No. 42C.)



Double-reduction right-angle, horizontal gear speed reducers; cast gray iron housing.

If you want details on a *complete selection* of speed reducers, cut gears, flexible couplings and gear motors, contact your D. O. James representative or write to the factory, outlining your specific requirements.

D. O. JAMES GEAR MANUFACTURING CO. 561
1140 West Monroe Street, Chicago 7, Illinois
Since 1888, every type of cut gear and gear reducer

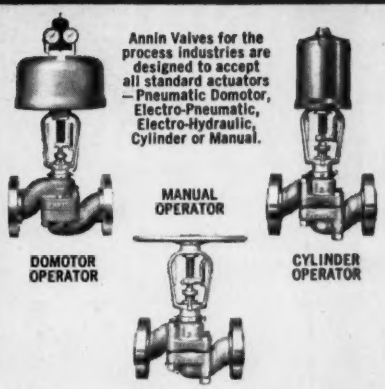


D.O.James

. . . where you always get good gearing

WHY ANNIN IS THE CHEMICAL INDUSTRY'S LEADING PRODUCER OF ALLOY CONTROL VALVES

...OVER $1½ MILLION IN ALLOY VALVE BODY PARTS CARRIED IN STOCK


Annin Valves for the process industries are designed to accept all standard actuators — Pneumatic Domotor, Electro-Pneumatic, Electro-Hydraulic, Cylinder or Manual.
MANUAL OPERATOR
DOMOTOR OPERATOR
CYLINDER OPERATOR

In specifying control valves, the Chemical Industry says make them *strong,* make them *light,* make them *versatile,* and by meeting these standards Annin has become the leading supplier of alloy valves for process control. The above photo, showing a portion of Annin's $1½ million inventory of alloy body parts, is in itself only part of the story. Annin's split body construction... easily replaceable trim... the flexibility of angle, or 3-way bodies immediately supplied from stock... the reduction in overall weight without sacrifice of strength... are other factors in Annin leadership. You can benefit by the inventory economy, ease of maintenance, and basic design advantages of Annin Valves... recognized by control engineers and valve designers as the outstanding valve development of the past twenty-five years for the control of hot, cold, erosive, corrosive, or viscous fluids. *Write today for General Catalog 1500-E.*

ANNIN VALVES

Products that work for your profit

THE ANNIN COMPANY
1040 So. Vail Ave., Montebello, Calif.

chemical processors!

no capital investment for an over-the-fence oxygen plant built with

LINDE / CERTAINTY

CERTAINTY that your final cost of oxygen will not be upped from the original estimate. CERTAINTY that your cost over the contract period will be as low as possible, in keeping with requirements for purity and trouble-free operation . . . the result of LINDE's advanced engineering features.

LINDE COMPANY
DIVISION OF UNION CARBIDE CORPORATION

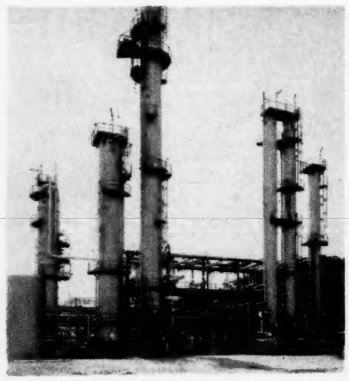
UNION CARBIDE

CPI NEWS BRIEFS . . .

Continued from page 108

Titanium, Ltd., a division of Laporte Industries, Ltd., is supplying process know-how; under the terms of the agreement as originally announced, Laporte would own 15% of the titanium dioxide operation.

Penn-Olin Chemical Co. has placed a 26,000-ton/yr. sodium chlorate plant on stream at Calvert City, Ky. The multimillion-dollar electrochemical unit incorporates "fully automated control and production systems." (Penn-Olin is a joint subsidiary of Pennsalt Chemicals Corp. and Olin Mathieson Chemical Corp. Pennsalt operates the sodium chlorate facility; Olin markets the product.) Sodium chlorate is a raw material for both chlorine dioxide, a paper-and-pulp bleach, and for ammonium perchlorate, a solid-fuel oxidizer.



Ashland Oil & Refining Co. has placed its second Udex unit on stream *(above)* at Catlettsburg, Ky. Licensed by Universal Oil Products Co., the Udex has daily capacity for 480 bbl. of benzene, 400 bbl. of xylenes and 320 bbl. of toluene from catalytic reformer product. Construction was completed in five months by Procon Inc.

American Viscose Corp. has announced a multimillion-lb./yr. plant for Newark, Del., to begin producing Avicel by next January. (A microcrystalline cellulose, Avicel is currently bidding strongly for use in preparing calorie-controlled and convenience foods.) Earlier this year, a semicommercial 1-million-lb./yr. Avicel unit

was placed in continuous operation.

Kaiser Aluminum & Chemical Corp.'s Kaiser Refractories Div. plans a $1.6-million research facility at Moss Landing, Calif. Due completed by next summer, the center is aimed at developing advanced refractories and "accomplishing the final work" on a variety of new products currently being developed at the firm's Milpitas, Calif., laboratories.

Offices

The Permutit Co., a division of Pfauder Permutit Inc., has established a sales office in Dallas.

Hercules Powder Co. has opened a district office in the town of Louisiana, Mo., to handle sales and service of its agricultural products in a fourteen-state area.

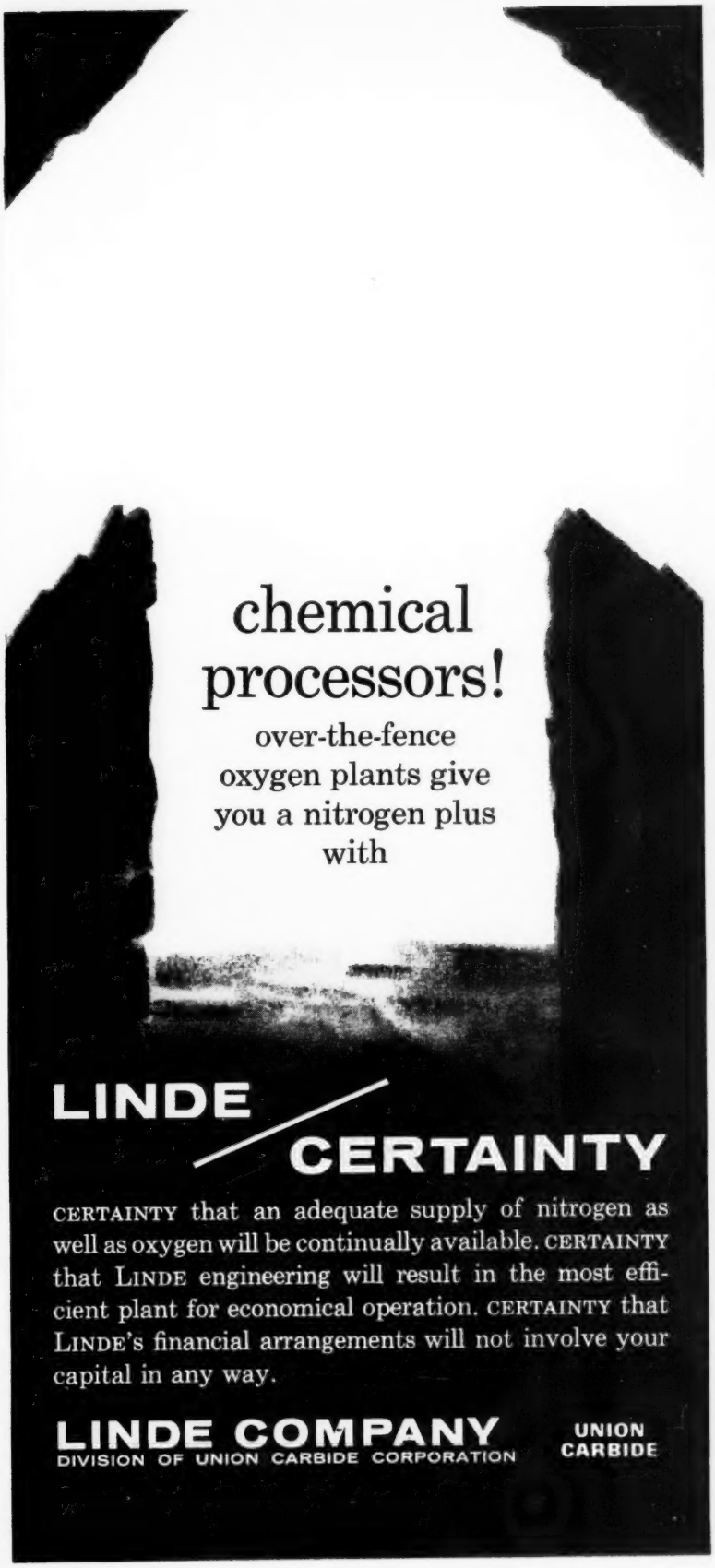
Monsanto Chemical Co.'s Agricultural Chemicals Div. will open a Chicago district sales office Nov. 1.

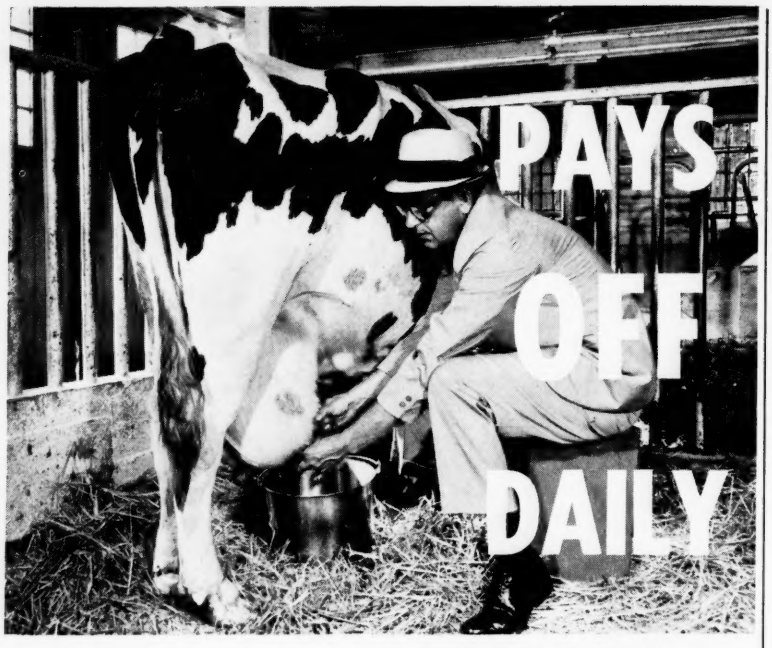
Bartlett-Snow-Pacific, Inc., San Francisco, which was recently created by consolidating Pacific Foundry and Metallurgy Co. with The C. O. Bartlett & Snow Co., has moved the predecessor companies' New York offices to 1270 Avenue of the Americas.

Miller-Stephenson Chemical Co. has moved its headquarters from South Norwalk to Danbury, Conn.

Companies

Cosden Petrochemical Corp. has been created by Cosden Petroleum Corp. to "perform marketing advisory services." Cosden Petroleum, in turn, is a subsidiary of W. R. Grace & Co. It broke into petrochemicals in 1952, with a benzene-toluene-xylenes plant; by fiscal 1961, petrochemicals were credited

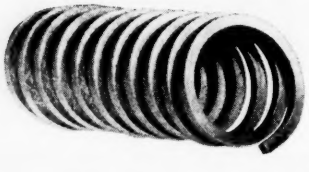

chemical processors!
over-the-fence oxygen plants give you a nitrogen plus with
LINDE / CERTAINTY
CERTAINTY that an adequate supply of nitrogen as well as oxygen will be continually available. CERTAINTY that LINDE engineering will result in the most efficient plant for economical operation. CERTAINTY that LINDE's financial arrangements will not involve your capital in any way.
LINDE COMPANY
DIVISION OF UNION CARBIDE CORPORATION
UNION CARBIDE



ONE RELIABLE SOURCE FOR ALL

MECHANICAL PACKING

REQUIREMENTS



It's the pay-off in a product that counts... What is the pay-off? — It's dependable service . . . the long life of the product... product efficiency... and the dividends it offers — such as lengthening the life of shafts, reducing friction and heat, and minimizing wear and maintenance requirements.

Who puts the pay-off in the product . . . EXPERTS — like those at HERCULES PACKING, whose years of experience and researching make the final pay-off to you possible.

Now is the time to make sure you discover the POSITIVE ADVANTAGES of dealing with HERCULES as your one reliable source for all mechanical packing requirements.

Free literature at your request on every type of packing requirement.

HERCULES PACKING CORPORATION

11061-E10 WALDEN ROAD ALDEN, NEW YORK

HERCULES PACKING

with a fourth of Cosden's net income—though barely 12% ($10.2 million) of total sales.

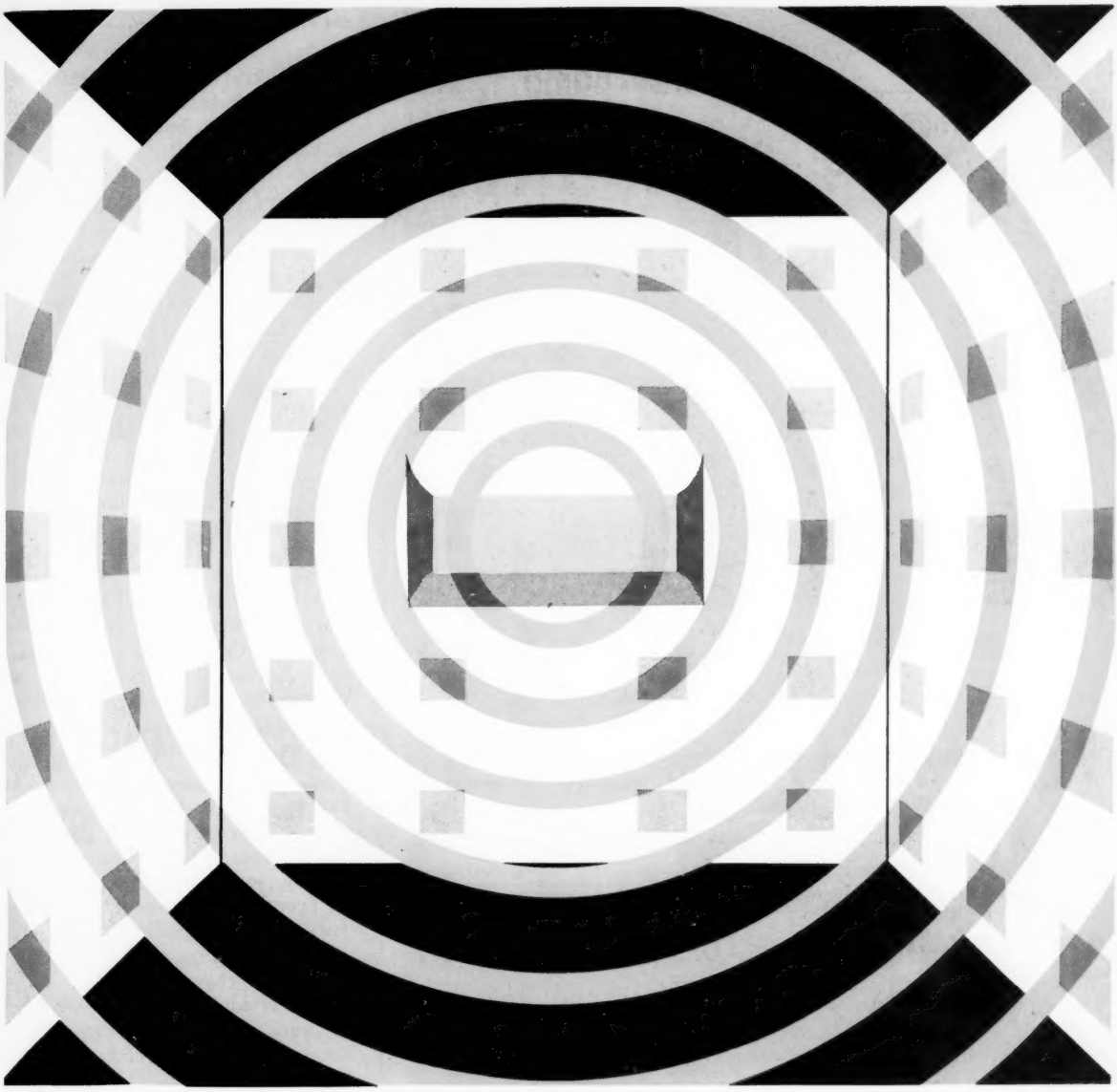
Dyna-Therm Chemical Corp., Culver City, Calif., has acquired Highland Stucco and Lime Products, Inc., Van Nuys, Calif. Transaction involved an undisclosed amount of cash and stock. Described as the second largest stucco and lime maker in southern California, Highland Stucco's 1960 sales were $1,014,000; Dyna-Therm's, $1,400,000. But Dyna-Therm posted an $11,000 net loss, while its new acquisition made pretax profits of $100,000. (Dyna-Therm recently whipped up trade interest by a high-temperature protective film that foams. See *Chem. Eng.*, June 26, p. 78.)

The Atlantic Refining Co., Philadelphia, has acquired majority interest in J. P. Frank Chemical and Plastic Corp., Brooklyn, N. Y. Henderson Supplee, Jr., Atlantic's president, says the move represents an initial step in the firm's diversification program, set to "broaden and accelerate" its activity in chemicals. The J. P. Frank firm makes polyvinyl chloride and copolymer resins, films and sheeting, as well as polyethylene film and sundry plasticizers and stabilizers.

Air Products and Chemicals, Inc., Allentown, Pa., has acquired **Delta Oxygen Co.**, Memphis, Tenn. Delta makes and distributes oxygen, nitrogen, argon, acetylene, hydrogen, and welding and cutting equipment, through facilities in Tennessee, Arkansas, Kentucky and Mississippi.

International

Sweden: Swedish Cellulose Co. has officially inaugurated its $18-million, 110,000-ton/yr. kraft paper mill at Munksund, near Pitea on the Gulf of Bothnia. Actually, facilities were placed in operation June 16, construction having been completed eight months ahead of schedule. About 90% of the out-



Ceramic Engineers at Ramtite mix imagination with Alcoa Aluminas to produce super refractory: 90-RAM

An example of the outstanding refractories The Ramtite Company has developed for steel mills is 90-RAM—a 90 per cent alumina ramming mix. Originally used to line laboratory furnaces in Ramtite's own research department, 90-RAM proved its dependability in 60 months of trouble-free service. Now it is being used in many of the largest steel mills for such versatile applications as continuous heating furnace hearths; facing of burner walls and side walls in slab reheating furnaces; forge heating furnace hearths; ferrous and nonferrous melting furnaces; soaking pit slag lines and in several parts of basic open hearth furnaces.

Advantages of 90-RAM include excellent resistance to very high temperatures, abrasion and deformation. In addition, 90-RAM can be laminated to other refractories, forming a monolithic bond which makes it ideal for facing and relining refractory surfaces.

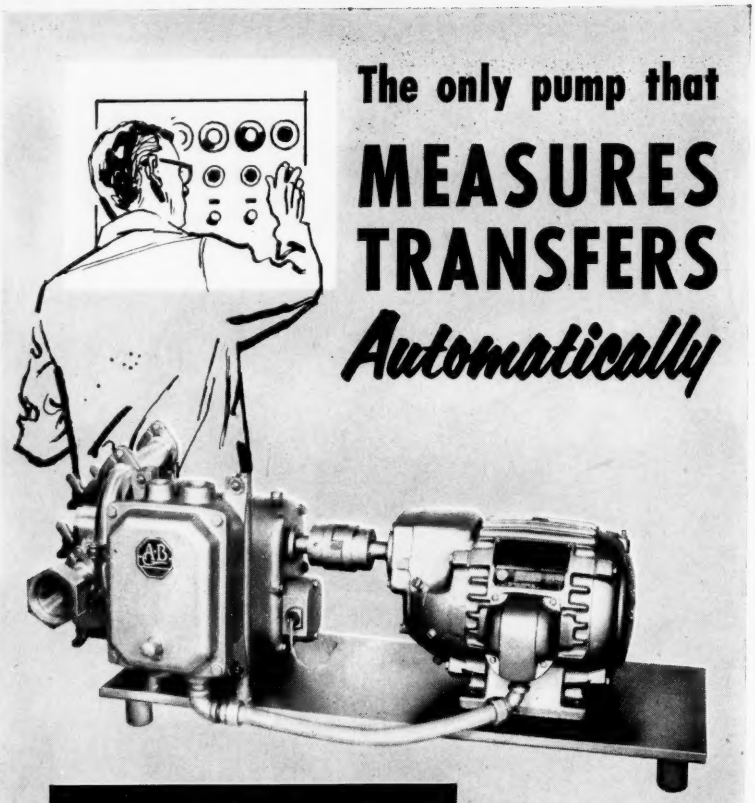
In meeting the needs of steelmaking and other high-temperature operations with a family of refractory materials, Ramtite *mixes imagination with Alcoa® Aluminas*—for excellence in refractory performance at reasonable cost.

Alcoa is not a source for finished refractories. It can supply in unlimited quantities the high quality aluminas that make modern refractory performance possible. Write to Aluminum Company of America, Chemicals Division, 705-K Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA CHEMICALS

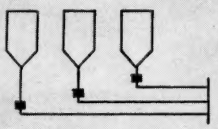
ALUMINUM COMPANY OF AMERICA

Entertainment at Its Best . . . **ALCOA PREMIERE** with Fred Astaire as Host . . . Tuesday Evenings, **ABC-TV**



The only pump that
MEASURES
TRANSFERS
Automatically

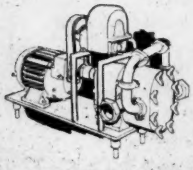
WAUKESHA
MFC
METERED FLOW CONTROL



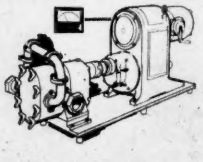
BATCH or CONTINUOUS – ACCURACY + OR – 1/4 of 1%

Whether you pump a light liquid or an extremely viscous product, the Waukesha MFC will automatically measure *and transfer* with an accuracy of + or – ¼ of 1% at capacities to 100 G. P. M. This high degree of precision automates processing lines where accurate batch measurement or a continuous measured flow control is required. Perpetual inventory control. System may be manual or fully automatic including electronic controls.

Let a Waukesha engineer explain how the MFC can automate your product stream. Phone or write.



WAUKESHA FOUNDRY COMPANY



PUMP DIVISION

WAUKESHA FOUNDRY COMPANY, DEPT. 91-F, WAUKESHA, WISCONSIN

District Sales Offices: New York, Atlanta, San Francisco.
Distributors in major cities of U. S. A. and Canada.
Export Sales: FMC International, San Jose 8, California.

put, a kraft liner trademarked Nordliner, is earmarked for export to corrugated board and cover makers.

Italy: Work has begun in the Lucania district of southern Italy on a network of methane pipelines to pump over 2 million cu. ft./day of the petrochemical raw material from Ferrandina to Matera, Bari and Monopoli. Project is the initial step in creating a $160-million petrochemical industry, sparked by the discovery of methane reserves estimated at 33 billion cu. ft. in the Lucania area. Among the specific facilties planned: (1) a $51.2-million natural gas products plant to be built by Anic, the petrochemical affiliate of Italy's state-owned oil and gas monopoly, Eni; (2) a $48-million facility proposed by Ceramica Pezzi, Milan, to make caustic soda as well as plastics and other natural gas by-products; (3) a $24-million plastics unit by Montecatini.

India: Lederle Laboratories Private, Ltd., expects to have its $2.1-million fermentation plant at Buldar, to the north of Bombay, in production by the end of this year. To be manufactured are chlortetracycline, tetracycline and dimethyl chlortetracycline. Capacity is estimated at 10 tons/yr. of aureomycin and achromycin; total Indian tetracycline requirements are said to be about 25 tons/yr. Indian capital for the project (24% of total) is being provided by Atul Products Ltd., a dyestuffs manufacturer in which American Cyanamid has a 10% interest.

Canada: The world's first atomic-powered unmanned weather station is on the air. Designed and built for the U. S. Weather Bureau and AEC by The Martin Co., the station at Sherwood Head, Axel Heiberg Island, Canada, is beeping signals on temperature, wind and barometer data every three hours to a short-wave receiver at Resolute Bay, 225 miles to the southwest. The Martin Co. and Weather Bureau crew that installed the station will probably be unable to reach the iced-in out-

VISIT BOOTH
Nos. 456-506-556
28th Exposition of Chemical Industries

Another filtration "plus" from FE INC®

a NEW design in cloth belt discharge filters

Filtration Engineers — the company that pioneered string discharge for rotary vacuum filters — now introduces a cloth discharge filter with a completely automatic belt tracking mechanism. An exclusive drawstring type end seal compensates for fabric shrinkage. The cloth always tracks, always fits. The same design eliminates end leakage. Tested and proved, the new FEinc cloth discharge filter handles *thinner slurries* and produces *cleaner filtrates.*

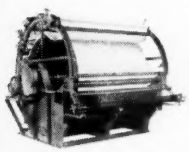
Features that help solve filtration problems

1. **HIGH CAPACITY** — Efficient handling of thin cakes with complete freedom from blinding. Filter cloth can be front and back washed during operation without dilution of slurry in filter tank. Sprays can be set for automatic cyclic or continuous operation.
2. **WIDE SIZE RANGE** — 5 to 600 sq. ft. of total area.
3. **RIGID DRUM CONSTRUCTION** — Center shaft of solid cold rolled steel.
4. **DRAINAGE SURFACE** — Self-supporting and is guaranteed against deflection.
5. **AGITATOR** — Overhead pin suspended.
6. **ACCESSORIES** — Compression and wash mechanism, multiple solution valves, level controls, cake beaters and other auxiliary devices.

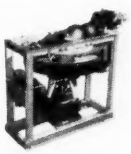
For technical data on the new cloth belt discharge filter or technical advice on your filtration processes, write Dept. CEF-1061 today.

For a Bigger Yield **FE INC®**

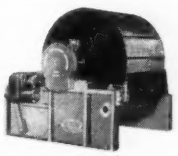
FILTRATION ENGINEERS
A DIVISION OF
AMERICAN MACHINE AND METALS, INC.
EAST MOLINE, ILLINOIS
CUSTOM DESIGNED CONTINUOUS FILTRATION



STRING



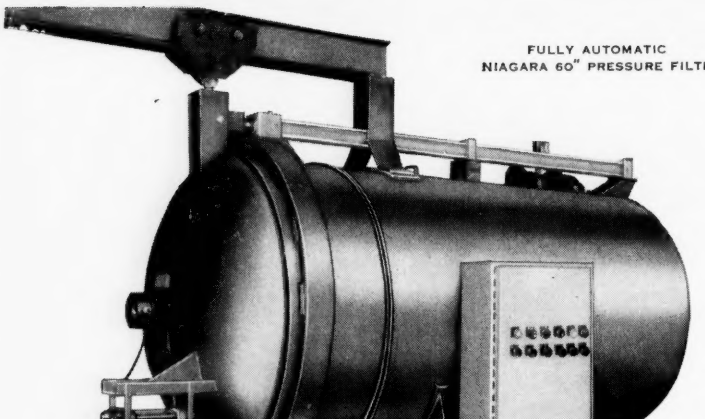
HORIZONTAL



SCRAPER

Divisions of American Machine and Metals, Inc.

TROY LAUNDRY MACHINERY • RIEHLE TESTING MACHINES • DE BOTHEZAT FANS
TOLHURST CENTRIFUGALS • FILTRATION ENGINEERS • FILTRATION FABRICS
NIAGARA FILTERS • UNITED STATES GAUGE • AUTOBAR • AUTOMATIC DEVICES
LAMB ELECTRIC COMPANY • HUNTER SPRING COMPANY • GLASER-STEERS CORPORATION



FULLY AUTOMATIC
NIAGARA 60" PRESSURE FILTER

VISIT BOOTH
NOS. 456-506-556
28TH EXPOSITION
OF CHEMICAL
INDUSTRIES

This filter controls itself

At any cycle variation from a pre-set pattern, this new, fully automated NIAGARA FILTER corrects the process. Triggered by excessive pressure, insufficient flow or maximum cake thickness, the filter STOPS, CLEANS ITSELF, then PRE-COATS ITSELF and STARTS FILTERING AGAIN. Sensitive electrical timing and hydraulic pressure controls "think" through an automated filtering process from start to finish. With human judgment errors eliminated, quality control gains a new measure of precision, flexibility and efficiency. For complete analysis of your filtration problem, send data today. Details of other NIAGARA filters are in Bulletin NC-457 and in Chemical Engineering Catalog. Write Dept. CEN-1061

Niagara®

NIAGARA FILTERS DIVISION OF
American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS

Specialists in Liquid-Solids Separation

DIVISIONS OF AMERICAN MACHINE AND METALS, INC. TROY LAUNDRY MACHINERY • RIEHLE TESTING MACHINES • DE BOTHEZAT FANS • TOLHURST CENTRIFUGALS • FILTRATION ENGINEERS FILTRATION FABRICS • NIAGARA FILTERS • UNITED STATES GAUGE • AUTOBAR • AUTOMATIC DEVICES • LAMB ELECTRIC COMPANY • HUNTER SPRING COMPANY • GLASER-STEERS CORPORATION

CPI NEWS BRIEFS . . .

post again until mid-1962, but the pound of strontium 90 generating the installation's power is designed to operate for two years without refueling or maintenance.

Yugoslavia's first petrochemical plant will be built near the Struzec oil and gas fields. Acetone and polyethylene are among the initial products slated for the 31,000-metric ton/yr. complex, for which undisclosed American interests have extended $23 million in credit. On-stream commissioning date has been set for late 1963.

France's first *cis*-polybutadiene plant is being blueprinted by Societe des Elastomeres de Synthese, a firm owned by Texas Butadiene, Shell, St. Gobain, Michelin, Dunlop and others. Unit is scheduled to come on stream by the end of 1963, with capacity for 20,000 metric tons/yr. of *cis* product. Announcement followed the signing of agreements between Shell and Goodrich-Guif on the one hand, between Shell and Montecatini on the other, to pool their *cis*-polybutadiene patents. Under the contract's terms, Societe des Elastomeres has exclusive license "in the first few years" to the *cis* routes of all three firms, as well as the right to use appropriate Ziegler-developed organometallic catalysts.

India: National Mineral Development Corp. of India, which is state-owned, plans a $14.4-million, 10,000-ton/yr. electrolytic copper installation at Rajasthan by early 1964. Project consultant will be Western Knapp Engineering Co., San Francisco. Immediate duty of the U.S. firm is the assessment of ore reserves at Rajasthan's nearby Khetri mines.

Japan: Two oil firms have received multimillion-dollar loans from their U.S. colleagues: (1) Toa Nenryo Kogyo got $10 million from its 50% owner, Standard-Vacuum Oil Co., to help finance a $27-million petrochemical plant at Kawasaki (*Chem. Eng.*, July 25, 1960, p. 160); (2) Nippon Oil Refining was awarded a $40-million loan by its U.S. affiliate, California Texas

Oil Corp., to be applied toward construction of a $76-million, 100,000-bbl./day refinery at Negishi, Yokohama, due on stream in the fall of 1963.

Belgium: Societe Industrielle Belge des Petroles (SIBP) has awarded Societe Foster Wheeler Francaise, Foster Wheeler Corp.'s French subsidiary, the construction contract for sundry new facilities at SIBP's Kruisschans refinery in Antwerp. Due on stream in the spring of 1963, expanded installation will have capacity to process 160,000 bbl./day of crude throughput, which is just double its current rating. Project cost: $30.8 million.

Finland: The International Bank for Reconstruction and Development has loaned $25 million to Mortgage Bank of Finland Oy, which will re-lend the proceeds to seven private firms in the nation's pulp and paper industry. Separate projects planned by the individual companies will cost an aggregate $113 million, boost annual Finnish capacities to 375,000 tons of sulfate pulp, 170,000 tons of newsprint and high-grade printing papers, and 80,000 tons of kraft paper. Construction of two of the projects has already begun, but most of the program will be executed in 1962-3, with completion due in 1964. The seven firms involved: Kymmene A/B, Oy Kaukas A/B, Joutseno Pulp Oy, United Paper Mills, Kajaani Oy, Oy Schauman A/B, and G. A. Serlachius Oy.

West Germany: Gelsenberg-Benzin A.G. plans a 40,000-bbl./day refinery near Neustadt in Bavaria, about 20 miles from Ingolstadt. Facility is due on stream by 1964—in other words, about the same time as three other refineries slated for the Ingolstadt area (proposed by Deutsche Shell A.G.: 40,000 bbl./day; by Esso A.G.: 70,000 bbl./day; and by Suedpetrol A.G.: 40,000 bbl./day).

Great Britain: Scottish Gas Board has awarded an $840,000 contract

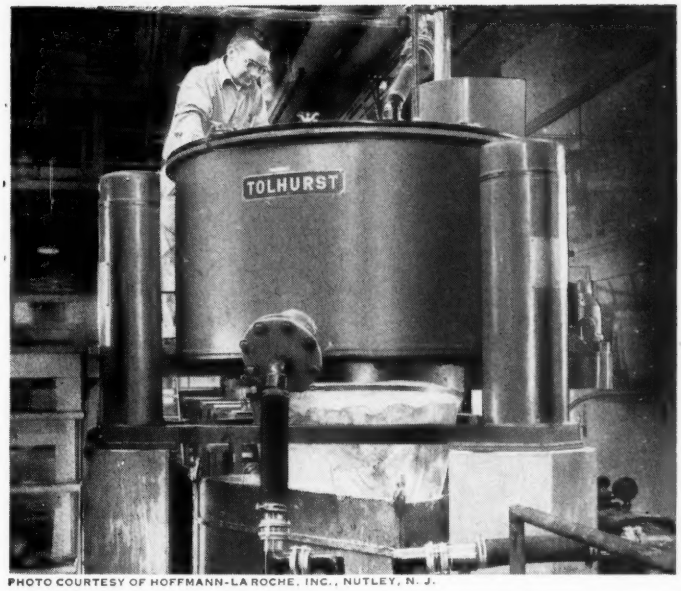


PHOTO COURTESY OF HOFFMANN-LA ROCHE, INC., NUTLEY, N. J.

Constant quality control and top efficiency with BATCH-O-MATIC®

This completely *automated* BATCH-O-MATIC reduces exposure time to maintain product stability in centrifugal extractor operations. These machines can be constructed of stainless steel, "Hastelloy," titanium or other alloys. Corrosion-resistant coatings may be specified.

Low, compact design and exclusive CENTER-SLUNG® suspension enable BATCH-O-MATIC to handle greater out-of-balance loads with minimum vibration. Low-speed plowing helps prevent crystal degradation. See complete data in the TOLHURST section of Chemical Engineering Catalog, or write today for further information or advice from experienced TOLHURST engineers.

VISIT BOOTH NOS. 456-506-556 28TH EXPOSITION OF CHEMICAL INDUSTRIES

MAIL COUPON TODAY

Tolhurst® CENTRIFUGALS

A DIVISION OF

American Machine and Metals, Inc.

Specialists in liquid-solids separation

Dept. CET-1061, EAST MOLINE, ILLINOIS

Please send illustrated details on the BATCH-O-MATIC. I'd also like information on TOLHURST manual models ☐.

NAME

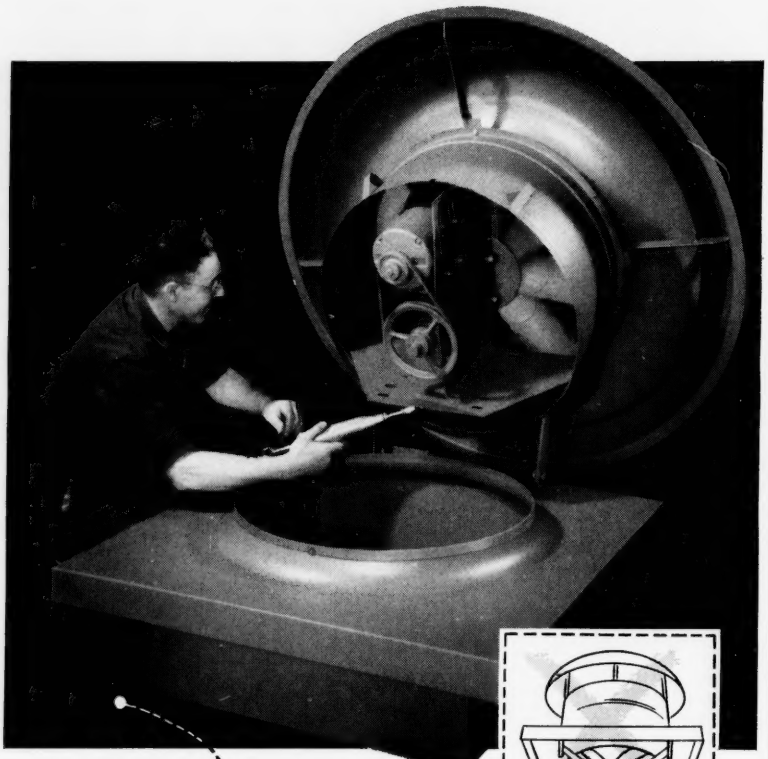
FIRM NAME

ADDRESS

CITY & ZONE STATE

Divisions of American Machine and Metals, Inc.

TROY LAUNDRY MACHINERY • RIEHLE TESTING MACHINES • DE BOTHEZAT FANS • TOLHURST CENTRIFUGALS • FILTRATION ENGINEERS • FILTRATION FABRICS • NIAGARA FILTERS • UNITED STATES GAUGE • RAHM INSTRUMENTS • LAMB ELECTRIC COMPANY • HUNTER SPRING COMPANY GLASER-STEERS CORPORATION



FLIP-TOP
ROOF VENTILATOR
cuts Maintenance Cost

Entire motor-and-fan housing may be flipped back 90° to make motor, drive assembly and fan conveniently accessible above roof level. Such easy access to all working parts for quick inspection cuts maintenance costs substantially by saving time and making the work easier.

This new DeBothezat "flip-top" Power-Flow roof ventilator offers fan wheels from 12" to 48" in diameter and capacities to 43,070 CFM. A Vertical Discharge Model exhausts dust and oil-laden air at high velocity, to disperse contaminants high enough to prevent their re-entry into building's air supply.

Write for illustrated Bulletin DR-7-61

VISIT BOOTH NOS. 456-506-556

28th Exposition of Chemical Industries

De Bothezat®

DE BOTHEZAT FANS DIVISION OF

American Machine and Metals, Inc.

Dept. CED-1061, EAST MOLINE, ILLINOIS

Divisions of American Machine and Metals, Inc.

TROY LAUNDRY MACHINERY • RIEHLE TESTING MACHINES • DE BOTHEZAT FANS • TOLHURST CENTRIFUGALS • FILTRATION ENGINEERS • FILTRATION FABRICS • NIAGARA FILTERS • UNITED STATES GAUGE • AUTOBAR • AUTOMATIC DEVICES • LAMB ELECTRIC COMPANY • HUNTER SPRING COMPANY • GLASER-STEERS CORPORATION

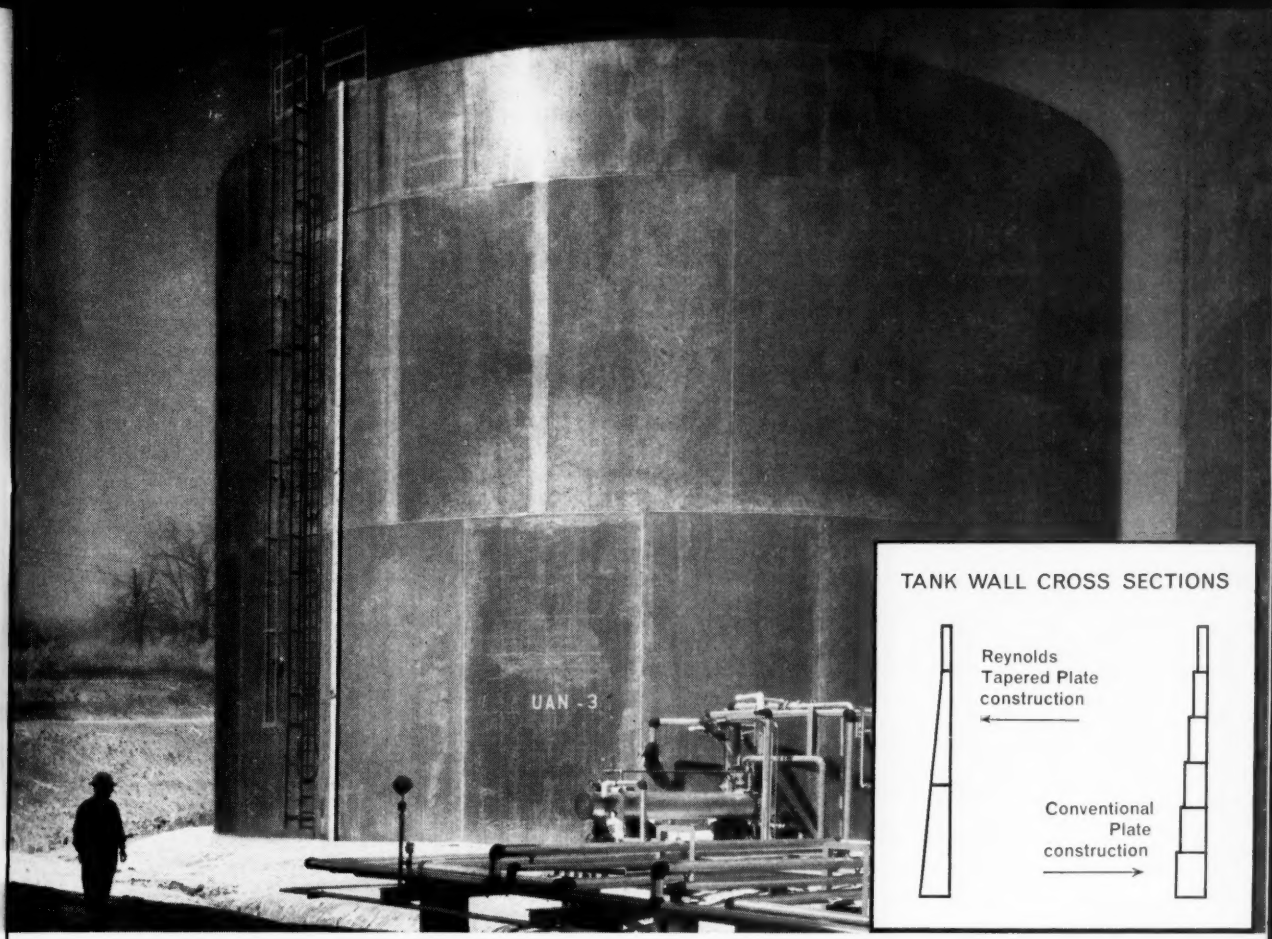
to Humphreys & Glasgow Ltd., London, to design and install Scotland's first gas-reforming plant at Granton, Edinburgh. To use the Onia-Gegi self-steaming route, the installation's two units will reform refinery gas into town gas. Daily capacity will be 18 million cu. ft. Contract's stipulated completion date is just under a year away.

Republic of China: Chinese Petroleum Corp., Allied Chemical Corp., and Socony-Mobil Oil Co. have signed a preliminary joint-investment agreement for a $22.5-million urea and ammonia facility on Taiwan. The Free Chinese firm will put up 30% of the capital; the two U. S. companies, 35% each. Allied has contracted to build the plant, designed to produce 100,000 metric tons/yr. of urea and 106,000 metric tons/yr. of ammonia from natural gas found in "substantial"quantities at Miaoli, about 80 miles southwest of Taipei. Bulk of the output is slated for sale to Taiwan Fertilizer Corp.

India: Hungary has offered India $30 million in credit to help develop Indian aluminum and pharmaceutical industries. Major item is a $40-million, 25,000-ton/yr. aluminum plant, site for which has yet to be selected. Offer stipulates that $16 million shall be applied toward this unit, with the balance to be used either for another aluminum plant or for creating pharmaceutical facilities.

Great Britain: Magnesium Elektron Ltd., sole metallic magnesium producer in Britain, is now a fully owned subsidiary of British Aluminium Ltd. Latter has bought out the 40% stake held by Distillers Co., Ltd., almost simultaneously announcing plans to build a 5,000-ton/yr. plant at Hopton, Derbyshire, to extract 99.9%-pure magnesium from local dolomite. A thermal route will be used. Installation will replace the original electrolytic plant, now uneconomic due to rising electricity costs.

Israel: Israel Petrochemicals Industries Ltd., capitalized at $15



Build tanks with less metal . . . less weight . . . less welding

REYNOLDS TAPERED ALUMINUM PLATE

Here's a new development that can—and will—cut tank construction costs: Reynolds *tapered* aluminum plate. This new plate permits tapered wall construction with no waste metal, no extra weight, no extra handling and shipping cost.

Before tapered plate, you had to pile course upon course, "stepping" the plate thicknesses down for each course. But with Reynolds tapered aluminum, the edge of one plate is tapered precisely to the thickness of the plate above it. Result: important savings in metal weight, shipping cost, and welding in tank construction.

Nooter Corp., St. Louis, Mo., recently built three tanks 70 ft. in diameter, 48 ft. high, for Chemical Construction Corp. at the Cooperative Farm Chemicals Assn. plant in Lawrence, Kan. Two tanks using conventional aluminum plate weigh 131,200 lbs. each. The other, built with Reynolds tapered aluminum plate, weighs 124,000 lbs.—7,200 lbs. less!

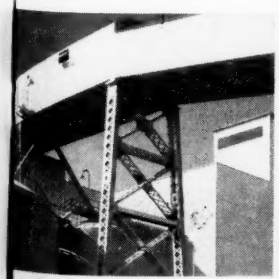
This weight savings meant lower shipping costs, lower handling costs in the plant and at the erection site.

Welding costs, too, were lower with Reynolds tapered plate. It took just three rows, or courses, two of which were tapered plate, to make the 48 ft. height; with all conventional plate, six courses were needed, requiring that much more welding. And welding is *faster* with tapered plate, because welding speed increases with thinner sections.

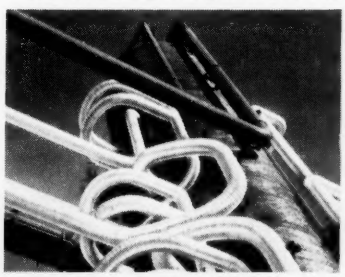
Reynolds can produce tapered plate in widths up to 11 feet, lengths up to 45 feet. In many tanks this can eliminate all horizontal welds.

Before you plan your next tank construction, check the savings possible with this new development in aluminum plate design, with Reynolds. For details and specifications, call your local Reynolds office, or write *Reynolds Metals Company, P. O. Box 2346-CJ, Richmond 18, Virginia.*

REYNOLDS ALUMINUM FOR CHEMICAL PROCESSING



Strong, Lightweight Structurals



Clean, Low-Maintenance Jacketing

Low-Cost, Rustfree Process Pipe

Watch Reynolds exciting TV programs on NBC: The Dick Powell Reynolds Aluminum Show

COLD END LEAD BREAKAGE ELIMINATED

in MgO thermocouples

conax®

T-3 TERMINATION

Optimum MgO thermocouple performance (and ultimate economy) requires that no phase of design or manufacture be overlooked. Conax demonstrates this fact from tip to termination. The T-3 termination's exclusive strain harness design takes all the stresses on the lead wires away from the thermocouple wires. Conax builds in additional value by electrically welding the junctions, thus eliminating corroding and contaminating fluxes that shorten thermocouple life. These are just a few of the facts that make Conax the truly economical thermocouple buy.

TAKE A TIP – GET ALL THE FACTS ON:

Con-O-Clad . . . ask for catalog 300

Thermocouple Assemblies . . . ask for catalog 1890

Electrode Glands . . . ask for catalog 960

Standard "24 Hour Delivery" thermocouples . . . ask for catalog 2400

conax *CORPORATION*

2305 Walden Avenue • Buffalo 25, New York

million, has been created by local, U.S. and Brazilian interests to own and operate facilities at Haifa for the production of undisclosed tonnages of ethylene, polyethylene, carbon black and detergent alkylates. Complex will supply raw materials to the nearby, 10 to 12-ton/day polyvinyl chloride plant already under construction by Electrochemical Industries (*Chem. Eng.*, June 12, p. 286).

West Germany: Caltex Oil Germany GmbH.'s refinery planned for Kelsterbach, near Frankfurt, will process 40,000 bbl./day of throughput from either the Rotterdam-Ruhr or the Marseille-Karlsruhe pipeline. Caltex figures that pipeline extensions, along with expanded sales facilities, will add $50 million to the $50 million already required for refinery construction. Roughly 30% of the output—olefins and other petrochemical building blocks—will go to Farbwerke Hoechst A.G.

Japan: Sekisui Chemical reports that agreement has been reached on the proposed export to Peru of a 20-ton/mo. polyvinyl chloride pipe plant. Deal was arranged through Nichimen Industrial Trading Co., which will supply raw material for the unit; Sekisui will furnish know-how.

India: The estimated cost of a 750,000-ton/yr. crude oil refinery still under construction at Gauhati, Assam state, has been revised. New total is pegged at $35.4 million. Originally slated to go on stream earlier this year, installation now isn't expected to begin producing until December at the earliest. Complex is being constructed with Rumanian aid.

People

Carl E. Reistle, Jr., has been elected president of Humble Oil & Refining Co. Interesting note in his biography: Reistle began his

TSE
TANK STORAGE ENGINEERING
fire prevention and vapor control

The Protectoseal Company, 1948 South Western Avenue, Chicago 8 • October, 1961

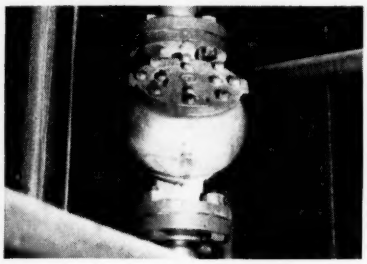
Vent INSIDE Building Solves Problem for Chemical Plant

Process kettles in a large chemical plant were vented to outside air by a pipe extending through the roof Each pipe was fitted with a terminal flame arrester vent. Inspecting the vent was a problem, due to the pitch of the roof. Each time a maintenance man had to get on the roof, the company's safety department insisted that scaffolding be erected to protect the men from a possible fall.

Aside from being difficult to maintain, the terminal flame arresters posed two other problems:

(1) Atmospheric conditions caused corroding of the flame arrester grids and housing.

(2) Flame arrester grids frequently plugged up in cold weather during kettle bleeding operations. Under certain conditions of temperature and humidity the grids would plug up in a matter of hours.



The solution to the problem proved to be fairly simple. The terminal flame arrester vents were replaced by Protectoseal 4950 Series In-Line Vents which were installed *inside the building* in such a manner that maintenance personnel had ready access to them. This not only eliminated the necessity of erecting scaffolds each time an inspection or maintenance of the flame arrester vents was necessary, but it also proved to be the answer to the problem of grid plugging.

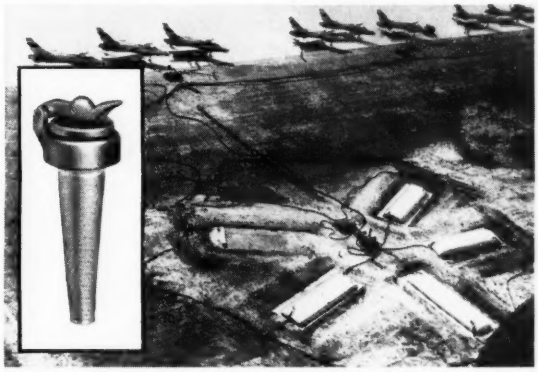
After installation of the In-Line Flame Arrester Vents, it was found that the grids remained opened for as long as two months.

Protectoseal 4950 In-Line Flame Arrester Vents are designed for efficient operation and easy maintenance. The circular plate type flame arrester structure embodied in the vents can be quickly removed (see photograph) for inspection or cleaning. Arrester structures are interchangeable to permit insertion of a clean spare arrester for positive protection at all times.

Standard construction of Protectoseal In-Line Flame Arrester Vents: Cast aluminum housing and aluminum flame arrester plates. The Vents are also available with aluminum or cast iron housing and stainless steel arrester plates.

For further information,
Check Item 241a on Reply Card

PROTECTOSEAL Vent Used In Portable JET Fuel Tanks



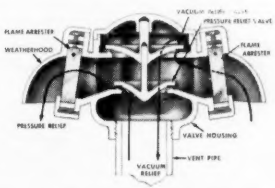
The TAF (Tactical Air Force) Mission frequently requires operating jet aircraft from advanced areas and temporary landing strips, where refueling facilities are not as complete as they are on fixed bases. Refueling speed, efficiency, and safety are most important.

A new tactical refueling system designed to accommodate 50,000 gallons of jet fuel in five rubberized nylon fabric tanks has been developed for use by the Air Force. The tanks, of 10,000 gallon capacity, are fitted with a special Protectoseal Pressure Relief Valve equipped with a conical perforated metal flame arrester. The lightweight cap assembly provides necessary pressure and vacuum relief for the tanks while they are being filled and/or emptied. The refueling system is capable of feeding 5 aircraft at one time at rates of 150 to 600 gallons per minute.

The tanks, necessary hose, fittings, and pumping apparatus weigh nearly 28,000 lbs. and can be airlifted to a forward base, set up, and be ready for refueling operations within 8 hours. In the photograph, four of the tanks have been filled. The fifth tank is seen still rolled.

CONSERVATION VENT Eliminates Flame Arrester Clogging By STYRENE MONOMER VAPORS

Problem: Vapors of styrene monomer (Flash Point of 90°F requires flame arrester protection) stored in chemical manufacturer's horizontal 30,000 gallon tank at atmospheric pressures and temperatures were polymerizing and clogging the flame arresters. Design of the vents installed on the tank was such that the flame arrester structure was *inside* the vent body, thus exposing arrester to constant emission of vapor, which lead to clogging. Various means of keeping flame arresters open were tried. None were successful.



Solution: A Protectoseal Series 830 Conservation Vent (illustration) which has the flame arrester structures *outside* the valve housing, was installed and proved to be the answer to the problem. Because flame arresters were outside the valve, they are exposed to the vapors only when the valves are open.

Result: After installation, the Protectoseal Valve was checked weekly during an 11 month period . . . including hot summer months when clogging had been most severe . . . and no clogging of the valves or arrester structures was observed.

For further information, Check Item
241b on Reply Card

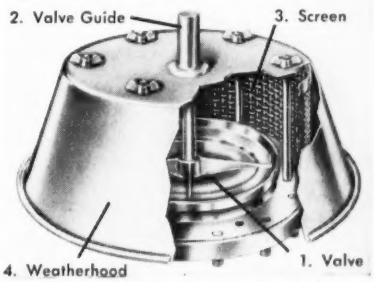
New Emergency Relief Valve

A new series of emergency relief valves has been developed by The Protectoseal Company to provide emergency relief capacity beyond that furnished by the operating vent on tanks, low pressure vessels, and piping. The new 7800 Series Valves are made with 8", 10", and 12" flanged connections for 125 lb. ASA mounting.

Abnormal heat rise in flammable liquid storage tanks leads to vaporization of the liquid, causing pressure build-up, which unless relieved, could cause tank rupture or explosion.

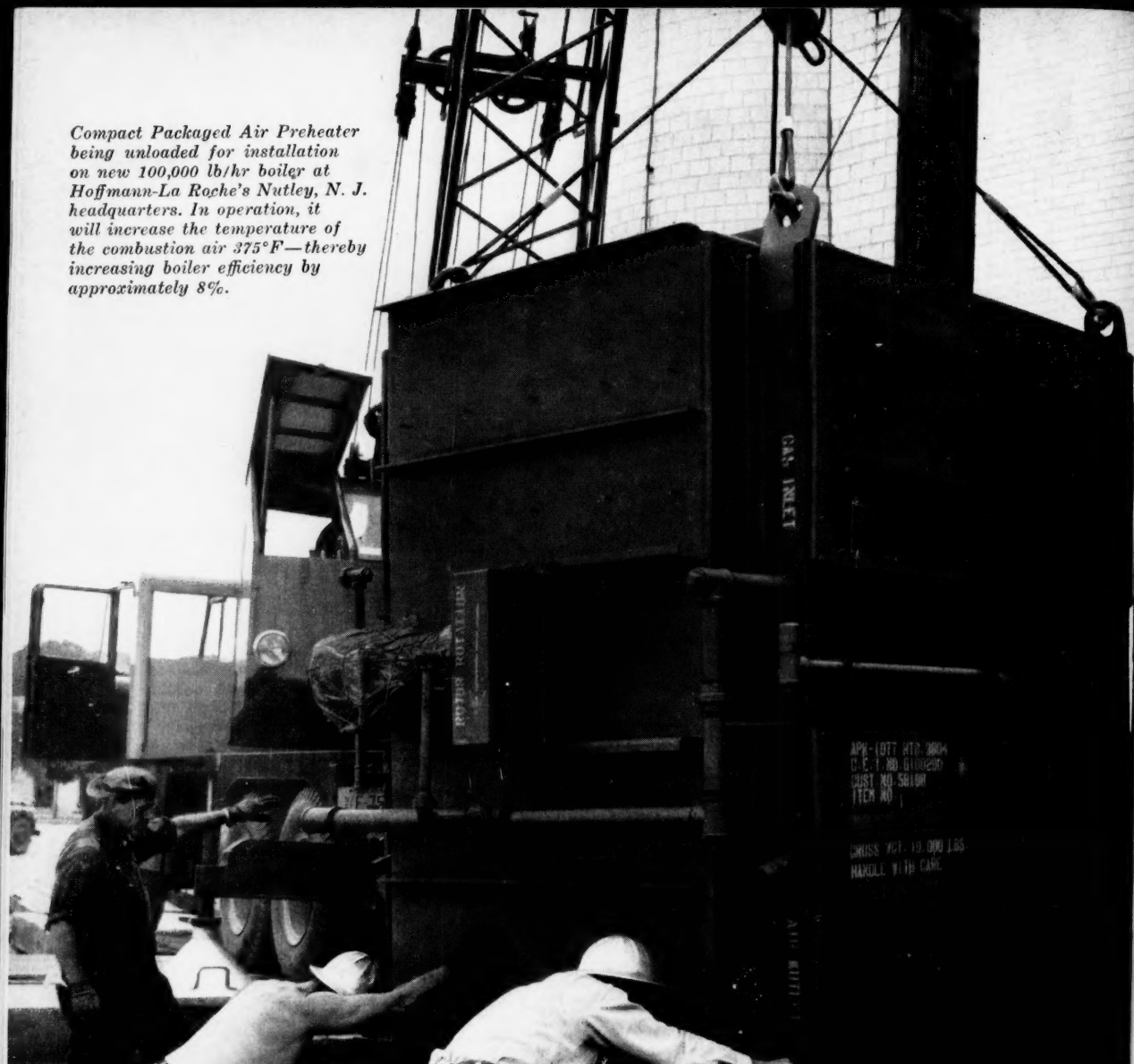
Series 7800 Valves incorporate a free lifting, self-closing valve designed to relieve at 1 ounce sq. in.; settings up to 10 ounce sq. in. can be provided.

A metal-to-metal seat is provided by a machined surface on the flanged aluminum base and the underside of the valve. A non-metallic seat to meet special operating requirements is available. A coarse mesh galvanized screen is provided around the valve to prevent entry of foreign matter. A weatherhood covers the entire valve structure.



Series 7800 Emergency Relief Valve

For further information, Check Item
241c on Reply Card



Compact Packaged Air Preheater being unloaded for installation on new 100,000 lb/hr boiler at Hoffmann-La Roche's Nutley, N. J. headquarters. In operation, it will increase the temperature of the combustion air 375°F—thereby increasing boiler efficiency by approximately 8%.

PACKAGED AIR PREHEATER

WILL RECOVER 330°F FROM NEW BOILER FOR HOFFMANN-LA ROCHE INCORPORATED

Hoffmann-La Roche, one of the leading producers of pharmaceuticals, vitamins and aromatic chemicals, specified a Ljungstrom Packaged Air Preheater for their new boiler for three reasons: 1) This compact, preassembled unit is ready to run as soon as it's connected to the power line and ducts—no extra installation or erection costs; 2) The unit occupies only about 450 cubic feet of space but will cut boiler exhaust temperatures from 680°F to 330°F—for about 8% saving in fuel; 3) Savings in fuel alone—roughly 1% for every 40°F drop in exit gas temperature—can pay for the unit in two short years!

Packaged Ljungstroms are available in sizes for use on boilers in the 25,000 to 250,000 lb/hr range—can give you these same fuel saving advantages. For full information, write today for our 14-page Packaged Air Preheater booklet.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

oil industry career as a roustabout for The Carter Oil Co. on summer vacations, while earning his B.S. in chemical engineering from the University of Oklahoma.

Vincent N. Hurd has been appointed manager of Gulf Eastern Co.'s just-formed, London-based, Petrochemicals Dept.

Robert E. Harroun has been promoted to supervisor of metals process development for Wyandotte Chemicals Corp.

Will Mitchell, Jr., is the new director of Allis-Chalmers Mfg. Co.'s Research Div. He has been acting director since Sept., 1960.

James W. Hackett has been appointed director of engineering and research, as well as a vice president of the Administration Div., at Owens-Illinois Glass Co.

W. J. Price has been elected vice president of production for Western Petrochemical Corp.

Richard S. Abrams is the new manager of development at Union Carbide Olefins Co.

Richard H. Braunlich has been appointed manager of research and development for the Fibers Div. of American Viscose Corp. The post puts him in charge of the firm's rayon and acetate R & D work at Marcus Hook, Pa.

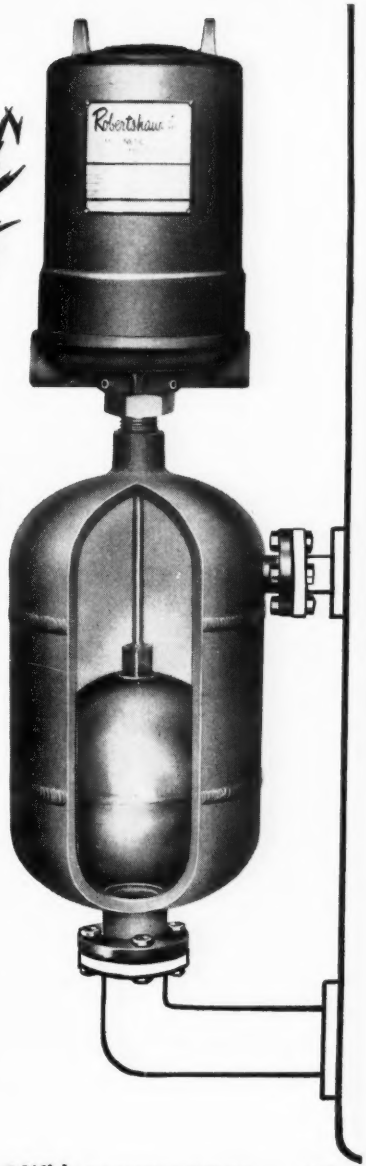
M. G. Kuhlman has been named technical director of East Texas Pulp and Paper Co., Silsbee, Tex.

Thomas L. Gresham has been elected a vice president of Air Products and Chemicals, Inc. He was formerly vice president of research and development for A. E. Staley Mfg. Co.

B. Ross Nason has joined Mobay Chemical Co. as director of manufacturing and engineering.

Arthur Minich has been appointed president of Heyden Newport Chemical Corp.'s Heyden Chemical Div.

NEW CERAMIC MAGNET Level Switches



FOR LIFETIME SERVICE . . . MULTIPLE FUNCTIONS

Start pumps, open or shut valves, sound alarms automatically . . . with these new high-load "Level-Ac" liquid level controls by Robertshaw, actuated by ceramic permanent magnets.

Designed for open or pressurized systems, these float-type switches provide constant control of levels in boilers, process vessels or other containers, with a long list of major advantages:

- **Extreme resistance to demagnetization** . . . highest of any commercial magnetic material.
- **Multiple switching functions** (up to 7 combinations) in small housing due to higher concentration of magnetic force.
- **Pneumatic or electric models** . . . explosion-proof housing available for electric switches.
- **Choice of mountings** . . . all-welded or flanged external float cages; top-mounting with tubular or 3-rod guides; side-mounting.
- **Wide pressure range** . . . pressure-equalizing floats for high-pressure applications.
- **Fewer moving parts** for trouble-free operation, lower cost.
- **"High-load" snap switch** . . . avoids need for leveling.

Just out! Complete description in new folder RC-765

Robertshaw

MR. CONTROLS

Robertshaw-Fulton Controls Company

FULTON SYLPHON DIVISION • KNOXVILLE 1, TENNESSEE

FILTER FABRIC QUIZ

How would you solve these filter fabric problems?

PROBLEM:

You're a soap manufacturer. You wish to filter foreign matter from oil and glycerin. What filter fabric would you use?

SOLUTION:

Closely woven cotton duck has withstood six months of this arduous service. For even longer life, nylon fabrics are recommended.

PROBLEM:

You're a dyestuffs manufacturer. You wish to separate a dye intermediate from a sulphuric and hydrochloric acid solution at 45°C. What filter fabric would you use?

SOLUTION:

A spun dynel fabric with high chemical resistance is both dependable and durable for this highly corrosive process.

PROBLEM:

You're a ceramics manufacturer. You wish to filter clay slurries. And the filter fabric must have good release characteristics and resist mildew and bacteria growth. What filter fabric would you use?

SOLUTION:

A tough fabric of filament nylon is sleek enough that the filter cake drops away at the touch of a scraper—and so durable that fabric life is multiplied many times.

PROBLEM:

You're a pigment processor. You wish to filter titanium dioxide from strong acid solutions with vacuum-type filters. What filter fabric would you use?

SOLUTION:

A fabric of filament Dacron*, highly resistant to mineral acids, provides smooth cake discharge and long service for maximum operating economy.

Each of these solutions is but one of many ways to solve these problems. For, as you know, countless factors help determine a filter fabric's performance—fiber, yarn, weave, count and finish, to name just a few. Selecting the most effective and economical filter fabric for a particular job is a very complex matter. And you need the assistance of a specialist—like the specialists who distribute Wellington Sears fabrics. These distributors are experts in the field of industrial fabrics—and always ready to lend a hand in helping solve your problems. For their names, and a free copy of our illustrated booklet, "Filter Fabric Facts," write Dept. L-10 today.

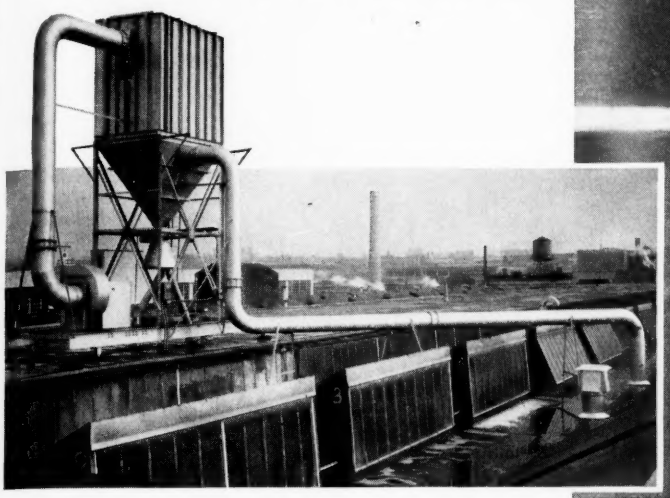
*DuPont trademark for its polyester fiber

WELLINGTON SEARS WEST POINT ® TEXTILES

FIRST IN FABRICS FOR INDUSTRY

Wellington Sears Company, 111 West 40th St., New York 18 · Akron · Atlanta · Boston · Chicago · Dallas · Detroit · Los Angeles · Philadelphia · San Francisco

Blended PVC is discharged from surge tanks and cooled to 100°F. enroute to the roof-mounted Multi-Bag Filter by the air in the 18″ pipeline. Dracco also supplied Circle with an Airstream Conveyor which automatically moves PVC to maintain working levels in extruder hoppers.



creative engineering from Dracco:

one dust collector does three jobs

In terms of plant operation, modern stands for simple, time-saving, economical, serviceable. When a plant is being modernized, it often takes creative engineering to design equipment which fits this description.

Take the case at Circle Wire & Cable Corporation, for instance. The Circle plant in Maspeth, New York, extrudes cable sheathing made from PVC. Dracco engineers were asked to design a system which would modernize the existing operation of moving PVC compound from blending bins to a cooler, then storing it in 55-gallon drums for further handling to extruders.

Here's the result: the cooling tank was eliminated; manual transfer of PVC compound from blender to cooler was also eliminated; and 55-gallon drums are no longer needed to store standard extrusion blend. In their place stands a Dracco Multi-Bag Filter with an 18″ intake line. The air in the line conveys the blend and, as an extra feature, cools it enroute. The filter collects the compound and discharges it to a ready bin for further conveying to extruder hoppers. Continuous flow of material improves quality . . . elimination of extra equipment and manual handling saves space and cost.

If you are modernizing a process involving dry bulk handling or dust control, take advantage of Dracco's creative engineering. For more information, call or write Dracco Division of Fuller Company, Harvard Avenue at East 116th Street, Cleveland 5, Ohio.

DRACCO *airstream* conveyors
dust control equipment

FULLER COMPANY GENERAL AMERICAN TRADE MARK

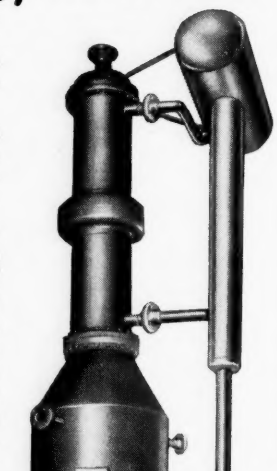
Vilter custom-designed Heat Exchanger helps produce high-energy missle fuel

Vital chemical processes, today, require the utmost in ingenious, reliable equipment.

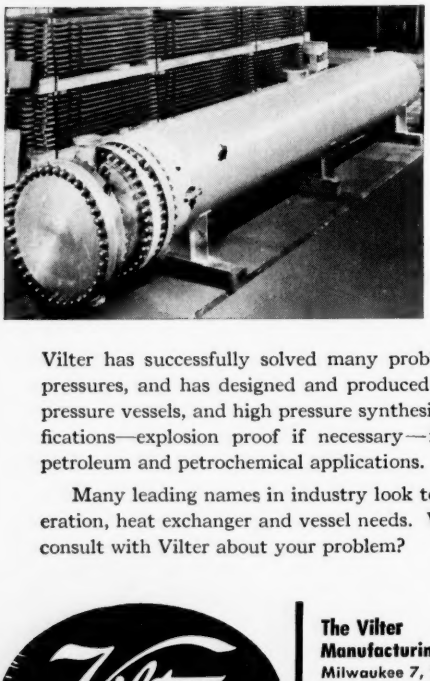
Typical of Vilter's contribution to America's strength and progress is the heat exchanger shown—an original Vilter design.

Custom designed to aid the production of solid boron fuel, this vessel is fabricated entirely of stainless steel. Separate condenser and receiver sections have been assembled into a single unit, ASME coded to −70° F., with propane used as refrigerant. Vilter designed, built and installed this unit to exacting design requirements.

Another example of the specialized vessels and heat exchangers Vilter designs and builds is the lean glycol amine solution cooler shown below. This kettle type, flooded Refrigerant-12 cooler has a floating head and removable tube bundle. 1140 square feet of heat transfer surface is contained in a 36″ O.D. by 23 ft. long shell.



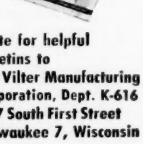
▲ Used in the production of solid boron fuel, this combination condenser receiver assembly is over 20 ft. high.



◀ 23 ft. long lean glycol amine solution cooler.

Vilter has successfully solved many problems of cooling under intense pressures, and has designed and produced hundreds of heat exchangers, pressure vessels, and high pressure synthesis condensers to exacting specifications—explosion proof if necessary—for many types of chemical, petroleum and petrochemical applications.

Many leading names in industry look to Vilter for their special refrigeration, heat exchanger and vessel needs. Why not consult with Vilter about your problem?



Write for helpful bulletins to
The Vilter Manufacturing Corporation, Dept. K-616
2217 South First Street
Milwaukee 7, Wisconsin

Vilter® refrigeration air conditioning

The Vilter Manufacturing Corporation
Milwaukee 7, Wisconsin
Air Units • Ammonia and Freon Compressors • Booster Compressors Baudelot Coolers • Water and Brine Coolers • Blast Freezers Evaporative and Shell and Tube Condensers • Pipe Coils Valves and Fittings • Pakice and Polarflake Ice machines.

Convention Calendar

October

23-26. American Institute of Mechanical Engineers, Metallurgical Society, Fall Meeting, Pick Fort Shelby Hotel, Detroit, Mich.

23-27. American Society for Metals, 43rd National Metal Congress and Exhibition, Cobo Hall, Detroit, Mich.

23-28. Institute of Chemical Engineers of Puerto Rico, 1st Inter-American Congress of Chemical Engineering, San Juan, Puerto Rico.

24-27. National Assn. of Corrosion Engineers, South Central Region, 1961 Conference and Exhibition, Shamrock Hotel, Houston, Tex.

25-26. Illinois Institute of Technology, Armour Research Foundation, 1961 Computer Applications Symposium, Morrison Hotel, Chicago, Ill.

26-27. High-Speed Testing, 3rd Annual Symposium, Hotel Somerset, Boston, Mass.

29-31. Fluid Control Institute, Fall Meeting, Hotel Hershey, Hershey, Pa.

29-1. National Lubricating Grease Institute 29th Annual Meeting, Rice Hotel, Houston, Tex.

30-1. Canadian Manufacturers of Chemical Specialties Assn., 4th Annual Meeting and Conference, Royal York Hotel, Toronto, Ont.

30-2. National Assn. of Corrosion Engineers, Northeast Regional Conference, Hotel Statler, New York, N. Y.

30-3. American Management Assn., Maintenance Management Course, Hotel Astor, New York, N. Y.

November

1-3. Industrial Management Society, Industrial Engineering and Management Clinic, Pick-Congress Hotel, Chicago, Ill.

2-3. American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, Los Angeles, Calif.

2-3. Society of Plastics Engineers, Inc., Plastics in Packaging, Sheraton-Dallas Hotel, Dallas, Tex.

2-3. Louisiana Polytechnic Institute, Annual Instrumentation Conference, Ruston, La.

6-8. Atomic Industrial Forum, Atomfair '61, Conrad Hilton Hotel, Chicago, Ill.

6-8. Chemical Institute of Canada, Chemical Engineering Division Conference, Royal York Hotel, Toronto, Ont.

6-10. American Management Assn., Manufacturing Management Course, AMA Academy, Saranac Lake, N. Y.

7-10. Packaging Machinery Manufacturers Institute, 1961 Show, Cobo Hall, Detroit, Mich.

10. Assn. of Consulting Chemists and Chemical Engineers, "Use of Technical Experts in Legal Work", Pittsburgh Hilton Hotel, Pittsburgh, Pa.

13-15. American Petroleum Institute, 41st Annual Meeting, Conrad Hilton Hotel, Chicago, Ill.

14-16. The Material Handling Institute Southwest Show, Dallas, Tex.

15-17. 1961 Eastern Analytical Symposim Statler-Hilton Hotel, New York, N. Y.

26-1. American Society of Mechanical Engineers, Annual Meeting, Statler-Hilton Hotel, New York, N. Y.

27-1. 28th Exposition of the Chemical Industries, New York Coliseum, New York, N. Y.

27.1. American Management Assn., Data Processing and Management Information Systems Course, AMA Academy, Saranac Lake, N. Y.

29-30. University of Michigan, "Effective Utilization of Engineering Personnel", Kellogg Center, East Lansing, Mich.

29-30. Oklahoma State University, Industrial Wastes Conference, Stillwater, Okla.

December

3-6. American Institute of Chemical Engineers, 54th Annual Meeting, Hotel Commodore, New York, N. Y.

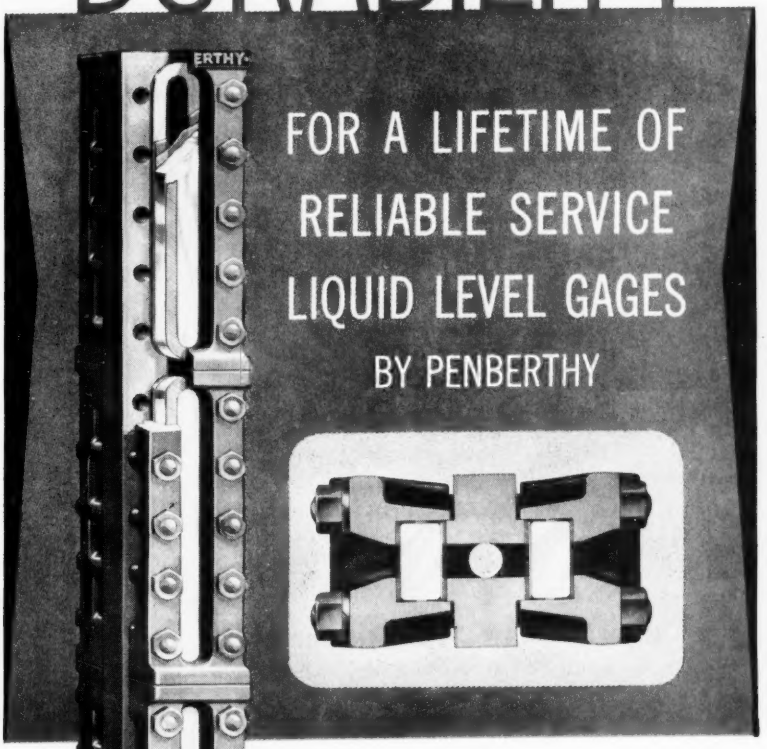
4-6. Chemical Specialties Mfg. Assn., Roosevelt Hotel, New York, N. Y.

5-6. Western Petroleum Refiners Assn,. Refiners Computer Conference, Hotel Tulsa, Okla.

7-8. Society of the Plastics Industry, 9th Plastic Film, Sheeting & Coated Fabric Conference, Pierre Hotel, New York, N. Y.

26-31. American Assn. for the Advancement of Science, Annual Meeting and Exposition of Science and Industry, Denver Hilton Hotel, Denver, Colo.

DURABILITY

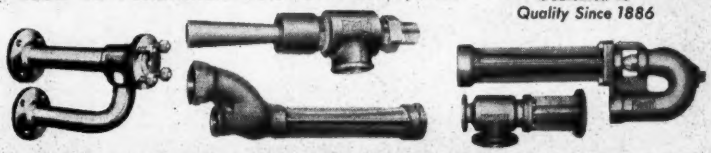


Design, materials, construction are combined in the manufacture of Penberthy Liquid Level Gages to provide the highest degree of rugged dependability. Liquid chambers are made in one piece from a solid bar of carbon or alloy steel and precision heat treated, machined and ground . . . for perfect, leak-tight alignment and rigidity. Covers, of temperature resistant steel, completely enclose sides and ends of glass and gasket . . . for blowout prevention. Pyrex glass is used exclusively . . . for its greater strength and resistance to shock and erosion. Even the gasket material is specially selected . . . for its high resiliency and ability to withstand excessive compression. In brief . . . For *lasting* accuracy in a liquid level gage, look to Penberthy.

PENBERTHY MANUFACTURING COMPANY
Division of Buffalo-Eclipse Corporation
PROPHETSTOWN, ILLINOIS
SALES OFFICE: 2660 E. GRAND BLVD., DETROIT 11, MICH.

PENBERTHY
Dedicated to Quality Since 1886

LOOK TO PENBERTHY FOR JET PUMPS, TOO

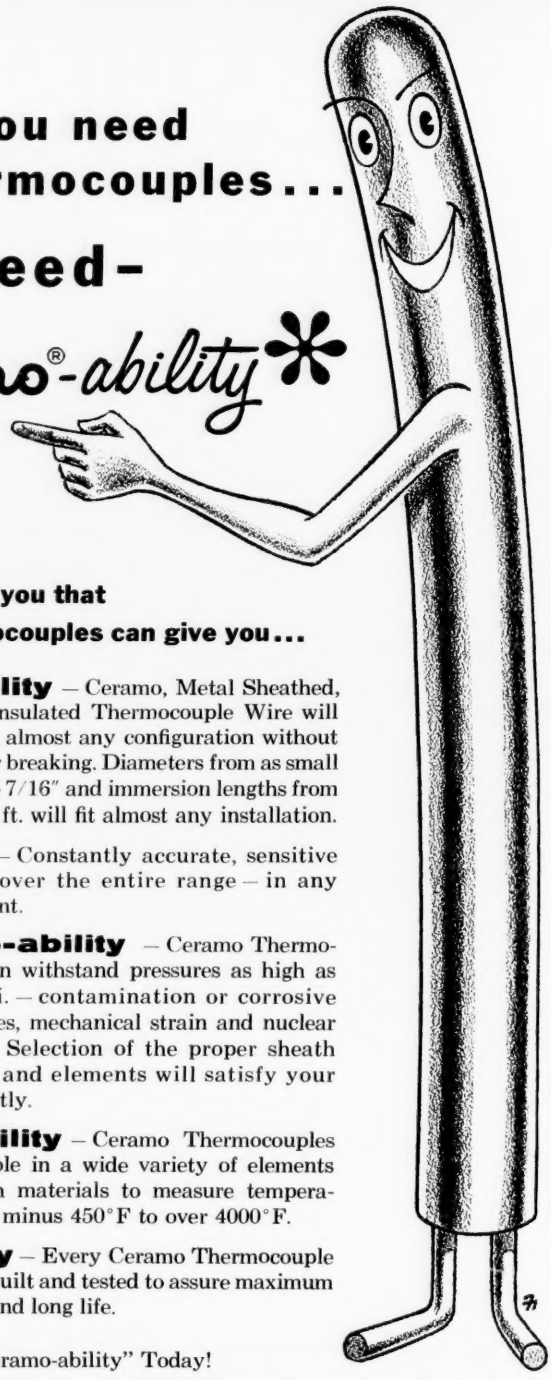


WRITE OR CALL PENBERTHY TODAY FOR COMPLETE INFORMATION

When you need Thermocouples...

You Need–

Ceramo®-ability*



Let us prove to you that
Ceramo Thermocouples can give you...

***Adaptability** – Ceramo, Metal Sheathed, Ceramic Insulated Thermocouple Wire will bend to fit almost any configuration without shorting or breaking. Diameters from as small as 1/25″ to 7/16″ and immersion lengths from 1/2″ to 70 ft. will fit almost any installation.

***Stability** – Constantly accurate, sensitive response over the entire range – in any environment.

***Stand-up-ability** – Ceramo Thermocouples can withstand pressures as high as 50,000 psi. – contamination or corrosive atmospheres, mechanical strain and nuclear radiation. Selection of the proper sheath materials and elements will satisfy your needs exactly.

***Rangeability** – Ceramo Thermocouples are available in a wide variety of elements and sheath materials to measure temperatures from minus 450°F to over 4000°F.

***Reliability** – Every Ceramo Thermocouple is quality built and tested to assure maximum efficiency and long life.

Find Out About "Ceramo-ability" Today!

WRITE FOR YOUR 48-PAGE THERMOCOUPLE CATALOG TC-4

–information on all Thermo Electric Thermocouples and accessories.

Thermo Electric

THERMO ELECTRIC Co., Inc., Saddle Brook, New Jersey
In Canada: THERMO ELECTRIC (Canada) LTD., Brampton, Ont.

20 YEARS • *Temperature Measuring Systems and Components*

NEW EQUIPMENT . . .

Continued from page 120

left to be done at the plant site.

Two units produce either 2,000 or 10,000 lb./day. Both also operate efficiently at a fraction of their rated capacities, according to the manufacturer. — **Girdler Corp., Louisville, Ky.** 120D

Flow meter

Rotary-piston unit is specially designed to handle corrosive liquids.

Acids and other corrosive liquids are metered by a device that incorporates a rotary piston and a magnetic coupling. Movement of fluid through the unit rotates the piston; rotation is transmitted without friction to the register by the coupling.

Measuring chamber and housing are made of different materials. The housing is cast iron, with all surfaces that contact the flowing medium lined with a modified phenolic resin. The measuring chamber is made entirely of the resin, which is characterized by high resistance to wear and a low coefficient of thermal expansion.

Flow-rate range is 1.3 to 26.5 gpm., at pressures to 142 psi. and temperatures to 87 F. Four different dials are available; the device may also be equipped with a

flow transmitter or integral-action ratio controller. — **T.E.A. Inc., Flushing, N. Y.** **248A**

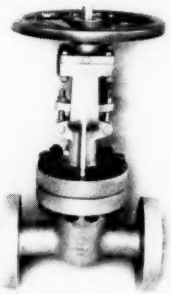
Ratio Controller

Small amounts of additives are measured and injected accurately.

A liquid ratio controller can combine two fluids at a 1:1,000 ratio, through flow ranges to 10,010 gpm., with an accuracy of 2%, according to the manufacturer.

The system meters flow of primary fluid by measuring pressure differential across an orifice. It then schedules the pressure differential across a metering orifice, to deliver a constant supply of additive at the required flow rate. A motor-driven additive pump supplies the metering system at a pressure level set by a pump relief valve.

An adjustable bypass flow path is provided in parallel with the additive-metering orifice plate for low-ratio trim. A second parallel path biases the additive flow as a function of temperature.—**Chandler Evans Corp., West Hartford, Conn.** **249A**



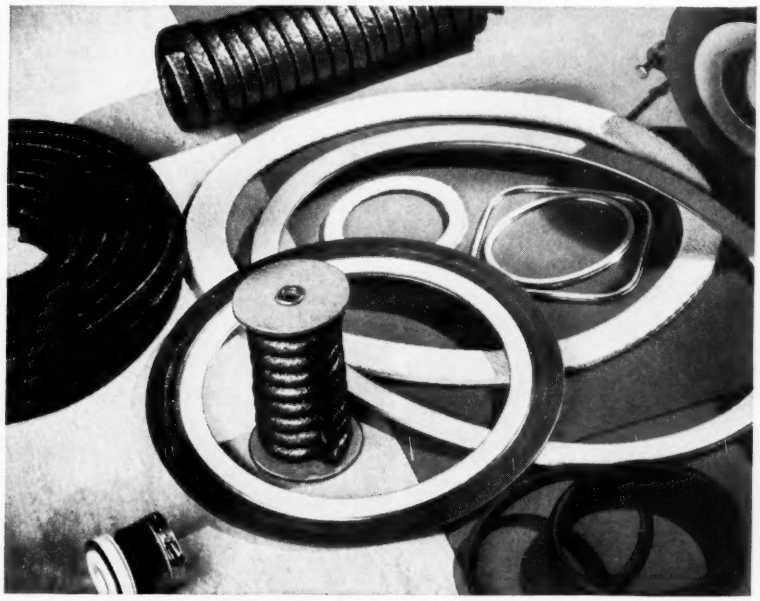
High-pressure valve

Gate, globe, "Y" and lift-check units handle most corrosives.

A group of valves designed for extreme service includes units for handling corrosive and reactive hydrocarbons and chemicals, as well as gate and globe valves de-

SOLD THROUGH INDUSTRIAL DISTRIBUTORS

Find the Belmont Distributor nearest you in Conover-Mast Purchasing Directory or Thomas' Register Packing Sections



THE MOST COMPLETE LINE OF MECHANICAL PACKINGS

Dependable Local Service • Always Available • Prompt Delivery

HIGH PRESSURE ASBESTOS • ROTARY PUMP PACKINGS • VALVE PACKINGS • V-RINGS • LEATHER PACKINGS • SHEET PACKINGS AND GASKETS • HYDRAULIC & PNEUMATIC PACKINGS • METALLIC PACKINGS • PLASTIC PACKINGS • TEFLON PACKINGS & GASKETS • SPIRAL WOUND GASKETS

Better Buy BELMONT

THE BELMONT PACKING & RUBBER COMPANY • PHILADELPHIA 37, PA.

STICKY PROBLEM:

HAPPY SOLUTION:

Molasses Dairy Feeds Clog Scale Openings

Stainless steel interiors of automatic feed weighing scales have long provided good service for users of Richardson Scales for weighing molasses content feeds. But as molasses content increased, so did the time and effort required for cleaning.

Usually twice-a-day cleaning sufficed. But the higher the molasses content, the faster the feed adhered and built up on all platework. Downtime for cleaning went even higher.

Now Richardson Scale Company uses R/M "Teflon" sheets wherever molasses feed makes contact with the scales. Field experience proves that now scales never clog, cleaning requires only a moist sponge instead of a metal scraper and only 1/10 as much time as before.

R/M Bondable "Teflon"* Cuts Cleaning Time 90%

Do you have an application which can utilize the non-adhesive property and low coefficient of friction of "Teflon"? Talk to R/M—headquarters for "Teflon" rods, sheets, tapes, hose, machined parts, with or without bondable surfaces. Write for information or call your nearest R/M district office.

*Registered TM for Du Pont fluorocarbon resins

R/M

PLASTIC PRODUCTS DIVISION

RAYBESTOS-MANHATTAN, INC.

Manheim, Pa.

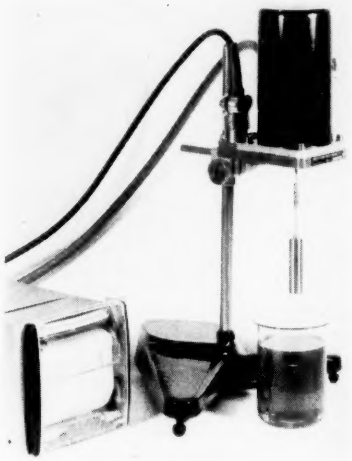
BIRMINGHAM 1 • CHICAGO 31 • CLEVELAND 16 • DALLAS 26 • DENVER 16 • DETROIT 2
HOUSTON 1 • LOS ANGELES 58 • MINNEAPOLIS 16 • NEW ORLEANS 17 • PASSAIC • PHILADELPHIA 3
PITTSBURGH 22 • SAN FRANCISCO 5 • SEATTLE 4 • PETERBOROUGH, ONTARIO, CANADA

SPECIALISTS IN ASBESTOS, RUBBER, ENGINEERED PLASTICS, SINTERED METAL

signed for cryogenic service. Various models available from ½ to 4 in. —cryogenic valves up to 14 in.

Corrosion-resistant models have internal areas designed to minimize turbulence. Tapered bearings are fitted into the yoke bushings of larger sizes to facilitate operation.

For cryogenic service, bonnets are extended to keep the handwheel and stuffing-box area away from the low temperatures, thus permitting the stuffing-box packing to retain its sealing ability.—**Alloy Steel Products Co., Linden, N. J.** 249B

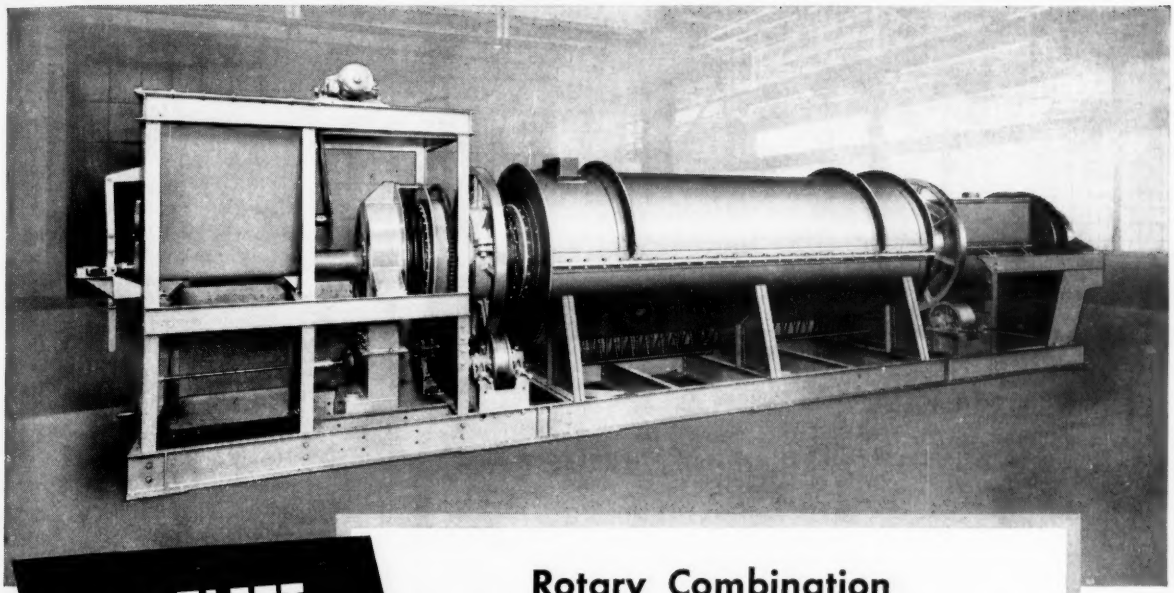


Viscometer

Instrument indicates and records over wide range of viscosities.

Viscosity measurements can be taken in closed or hazardous areas with an instrument that provides transmission of results up to 100 ft. away. Reading directly in centipoises, the device will determine such non-Newtonian properties as pseudo-plasticity, plasticity and dilatancy. It also yields flow curves of thixotropic, rheopectic, time- and temperature-dependent materials.

Portable and nonsparking, the unit gives readings from 0 to 64 million cps. The ratio of maximum to minimum range can be as high as 80,000:1 The instrument can be used with standard indicating and recording equipment, from



BARTLETT SNOW PACIFIC

Rotary Combination
CALCINERS
with Integral Coolers

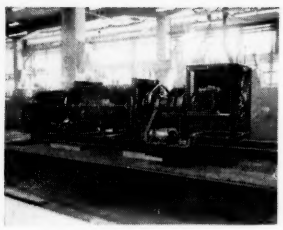
FIRST IN PREFERENCE

because they are

FIRST IN PERFORMANCE

B-S-P Combination Rotary Calciners and Coolers have no equal for heat treating ores, metal oxides, various chemicals, organic materials, regenerating catalysts and similar operations requiring a reducing, oxidizing or neutral atmosphere. Fuel fired and electrically heated designs. Temperatures to 2200°F. Materials usually can be cooled to 200°F before discharge.

The entire assembly including the furnace, feed hopper, seals, cooler and breechings are all supported on a single rigid frame. This maintains proper alignment of all parts and assures efficient, trouble-free, dependable operation.



Directly Above; B-S-P High Temperature Rotary Calciner Showing Electrically Heated Furnace and Integral Cooler. Across the Top; B-S-P Gas Fired Rotary Calciner Showing Feed Hopper, Furnace Chamber and Cooler.

B-S-P ENGINEERED EQUIPMENT

Bulletin No. 118-R will give you all needed information. We would be pleased to send you a copy.

Process Engineering Division, Dept. C-110

BARTLETT-SNOW-PACIFIC, INC.

6215 Harvard Ave.
Cleveland 5, Ohio

3100—19th Street
San Francisco 10, Calif.

1270 Avenue of the Americas
New York 20, New York

DRYERS • COOLERS • CALCINERS • KILNS • MULTIPLE HEARTH FURNACES

EVAPORATOR COSTS

...WHY YOU SHOULD CUT YOURS NOW

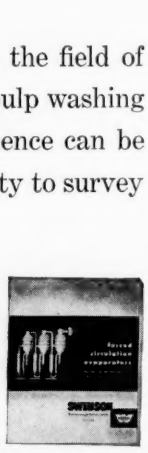
There have been many recent advances in evaporation techniques and equipment. Unless you are already enjoying their benefits, your competitive position may be vulnerable.

Modern evaporators can boost your capacity by converting batch operations to continuous production. They can cut your costs by improved recovery of chemicals, or by simplifying processes and procedures to save heat, power and labor.

Right now, while competitors watch and wait for a more auspicious economy, is THE TIME to cut ***your*** evaporator costs. Your investment will pay rich dividends of greater production at lower cost for markets of the near future.

Swenson engineers are acknowledged masters in the field of evaporation, as well as crystallization, filtration, pulp washing and spray drying. And the wealth of their experience can be made available to you. We welcome the opportunity to survey your evaporator problems.

FREE: Bulletin SW 205, *Forced Circulation Evaporators*, complete with charts and diagrams—well worth the reading time. Write to: Swenson Evaporator Company, 15669 Lathrop Ave., Harvey, Illinois. In Canada: Whiting Corporation (Canada) Ltd., 350 Alexander Street, Welland, Ontario, Canada.



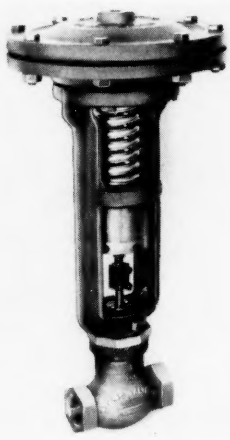
PROVED ENGINEERING FOR THE PROCESS INDUSTRIES SINCE 1889

SWENSON

WHITING — MANUFACTURERS OF CRANES; TRAMBEAM® HANDLING SYSTEMS; PRESSUREGRIP; TRACKMOBILES,® FOUNDRY, AND RAILROAD EQUIPMENT

A Division of WHITING Corporation

a simple pressure gage to a strip chart recorder. Transmission is pneumatic or electrical.—**Viscosel Corp., Stoughton, Mass.** 250A



Pressure-reducing valve

Unit controls pressure of liquids or gas, acts as pump governor.

A pressure-reducing diaphragm valve has O-ring construction, eliminating stuffing boxes. The valve can also be used as a pump governor, and is available in reverse-acting models.

Used to control pressure of steam, fuel oil, water, gas or air, the unit works with any pilot or 3-way hand control, if compressed air or hydraulic pressure is available. When used with properly selected thermostats, it serves as a reducing valve, relief valve, or temperature regulator.

Sized from ½ to 2 in., bronze-bodied model is good to 300 psi., 500 F.; for 600-psi. service, steel valve is available.—**Atlas Valve Co., Newark, N. J.** 252A

Plastic fittings

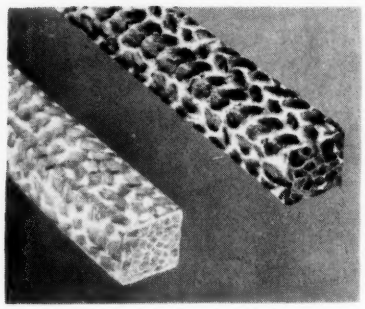
Unplasticized polyvinyl dichloride withstands higher temperatures.

Plastic fittings and flanges of unplasticized polyvinyl dichloride are usable at temperatures 60 deg. higher than previous vinyl piping materials, says the manufacturer. The injection-molded parts will

withstand temperatures to 215 F.

Schedule 40 and 80 fittings and flanges are now available in ½- through 2-in. pipe sizes, and 4-in. units will be made when larger pipe is commercially available. Chemical resistance is good against strong alkalis, acids and other corrosives.

Schedule 40 pipe handles 125 psi. at 185 F., weighs about one-sixth as much as copper, is self-extinguishing and has low thermal conductivity. The parts, made of B. F. Goodrich Chemical's Geon plastic, can be joined by solvent cementing or threaded joints.—**Tube Turns Plastics, Inc., Louisville.** 252B



Teflon packing

Carbon-free braided material eases break-in period after installation.

Said to provide better break-in characteristics than a former product that contained residual carbon, a new packing is braided of a pure white Teflon filament. Previously, the filament-production process had produced a grey-brown material containing carbon impurities.

The carbon-free material tends to eliminate excessive packing expansion during run-in operations. The elevated temperatures created by friction caused the carbon particles in the former packing to oxidize, raising the temperature further, so that the packing gland had to be adjusted frequently.

In addition to the heat-resistance feature, the white material retains the usual features of Teflon packing. The new and old

TANK CONTENTS AT-A-GLANCE with Dial-Type Liquidometer Gauges

For added assurance of accurate liquid quantity record keeping, specify easy-to-read Liquidometer gauges. Positive dial-and-pointer type indicators help to prevent erroneous readings . . . speed record keeping by showing tank contents at-a-glance.

Liquidometer gauges are available to measure and indicate virtually any liquid – at the tank site or remotely. Also available: integral or separate liquid level switches for automatic level warning or control. Float, hydrostatic, electric, or electronic operation can be supplied to meet your specific needs.

Let Liquidometer's forty years of experience in liquid level gauging and control work for you. Write for latest literature.

LIQUIDOMETER INSTRUMENTS

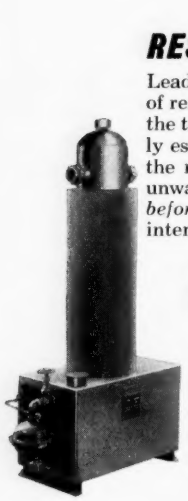
THE LIQUIDOMETER CORP.

Dept. Q, LONG ISLAND CITY 1, NEW YORK

Why REFRIGERATE to remove oil and water from compressed air?

RESULTS!.. **It's as simple as that!**

Leading authorities have proved that the most economical method of removing physical contaminants from compressed air is to lower the temperature of the air by refrigeration. Refrigeration effectively establishes a practical "dew-point." This practical dew-point is the means of collecting and effecting maximum precipitation of unwanted contaminants at a point in the compressed air system *before* damage to vital instruments and controls results. Sound interesting? Then take a closer look at the



AIR-ENGINEERED

REFRIGIFILTER

. . . a refrigerated "packaged" unit consisting of filter, separator, condenser, heat exchanger and automatic trap—ready to install, no extras! A closed-loop refrigeration cycle (to obtain −10° F. to −30° F. dew-points) is employed to precipitate vapors and separate entrained moisture and oil, dirt and sludge before these contaminants can raise havoc by plugging orifices, rusting and corroding vital parts of the instrumentation and pneumatic system. Complete data including installation drawings and specifications is available.

Send for Bulletin 902 today!

Hankison

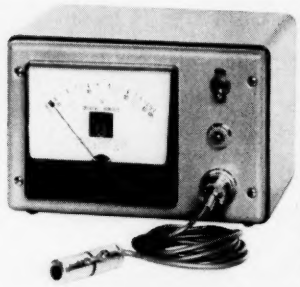
CORPORATION

College at Pike Canonsburg, Pa.

(Pittsburgh Area)

PREFERRED FOR PRACTICAL AIR DRYING

materials are contrasted in the illustration.—**Greene, Tweed & Co., North Wales, Pa.** **253A**

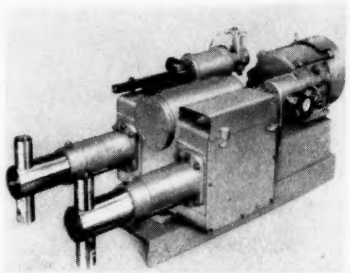


Humidity meter

Highly sensitive transistorized unit reads relative humidity instantly.

Using a sensing element whose electrical resistance changes instantly with changes in relative humidity, a new meter is said to be accurate to ±2%. When used for portable testing, it gives a quick check on the efficiency of drying equipment.

For continuous monitoring and readout, the unit can be permanently installed on an instrument panel. A switch device using the humidity sensing element is available for humidity-governed control systems. Humidity switches are frequently used in conjunction with temperature-sensing instruments.—**Telostat Corp., Hopkins, Minn.** **254A**



Proportioning pump

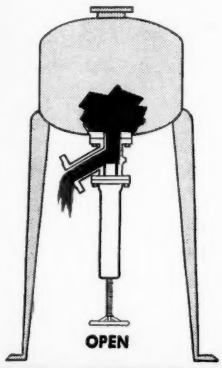
Capacity may be adjusted while reciprocating unit is running.

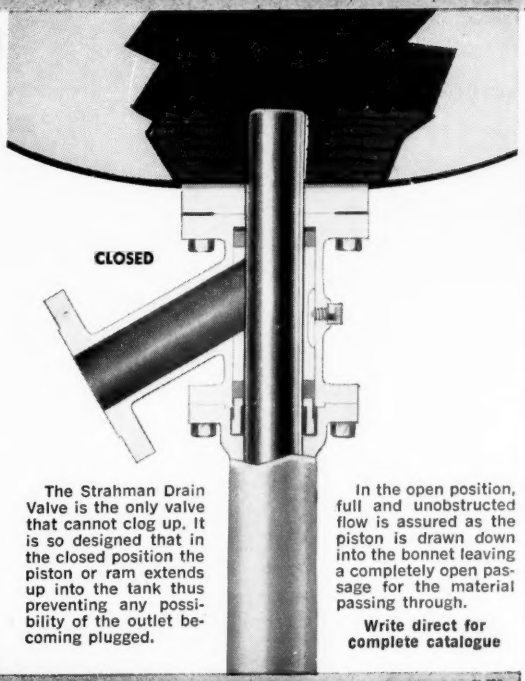
Called Strokontrol, a new proportioning pump uses a totally

Strahman RAM TYPE DRAIN VALVES

FLUSH BOTTOM VALVE
THAT WILL NOT CLOG

Designed for Chemical and Pharmaceutical industries





The Strahman Drain Valve is the only valve that cannot clog up. It is so designed that in the closed position the piston or ram extends up into the tank thus preventing any possibility of the outlet becoming plugged.

In the open position, full and unobstructed flow is assured as the piston is drawn down into the bonnet leaving a completely open passage for the material passing through.

Write direct for complete catalogue

STRAHMAN VALVES INC. NICOLET AVENUE FLORHAM PARK, N. J.

FI-593

An Effective Metal Cleaning and Etching Agent— for pre-treatment of metals and removal of oxide films. Leaves a unique surface that tends to improve bond characteristics of subsequently applied films.

KEEP PFIZER
CITRIC ACID
IN THE BACK OF YOUR MIND
TO SOLVE THE PROBLEM

Pfizer CHEMICAL DIVISION
New York 17, N.Y.
SCIENCE FOR THE WORLD'S WELL-BEING®

NEW SLANTS ON HEAT PROCESSING FROM SELAS

Selas GRADIATION® Heating for batch processing of polyester resins cuts material costs 20%!

To obtain the clarity, color and quality needed to make top quality molded boat hulls, sport car bodies and truck cabs, Molded Fiber Glass Company, Ashtabula, Ohio, built its own ¼-million dollar polyester resin plant. Equipped with two Selas GRADIATION batch processing systems, each designed around a setting of DURADIANT® burners, the plant saves 20 percent in resin costs . . . and will pay for itself in less than two years!

The fast, accurate response of DURADIANT burners to the panel-mounted temperature programmer guarantees (1) consistently high quality, (2) exact matching of specifications in batch after batch, (3) quick heating, (4) unvarying temperatures, and (5) rapid cooling as desired.

The DURADIANT burners create radiant heat by burning a controlled gas-air mixture against their special, cup-shaped, refractory surfaces. Although the kettle is only ten inches above the burner setting, no charring, uneven heating or resin degradation results, since all combustion occurs within the refractory cups. There are no flame tails to cause hot spots.

Why not investigate the Selas GRADIATION approach to the batch processing of a long list of heat-sensitive materials . . . including yours? For details, write to General Industry Division.

SELAS CORPORATION OF AMERICA
810 Dreshertown Rd., Dresher, Pa.

EUROPEAN SUBSIDIARY: Selas Corporation of America, European Division, S. A., Pregny, Geneva, Switzerland. INTERNATIONAL AFFILIATES: Australia, Benelux, France, Japan, Portugal and Spain.

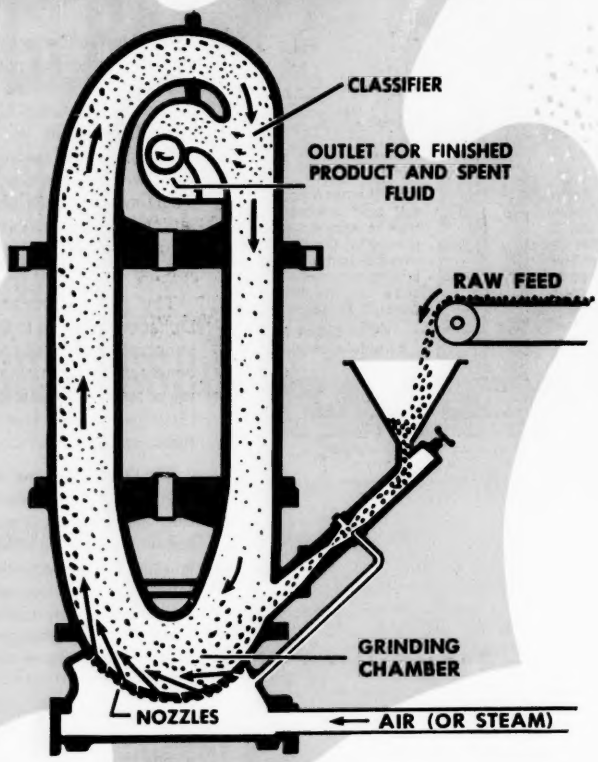
GRADIATION and DURADIANT are registered trademarks of Selas Corporation of America.

SELAS

HEAT AND FLUID PROCESSING ENGINEERS
DEVELOPMENT / DESIGN / CONSTRUCTION

for GRINDING AND DEHYDRATION
FINER PARTICLES
LOW MAINTENANCE

FLUID ENERGY JET-O-MIZER MILLS



The Fluid Energy "Jet-O-Mizer" Mill, designed and built by the pioneers in fluid energy fine grinding, does far more than produce fine particles. It controls fineness and product quality with a narrow distribution range and simultaneously with grinding can dehydrate, coat particles, blend and achieve chemical changes.

Jet-O-Mizer Mills are being used all over the world, processing many types of materials in the following industries:

- Abrasive
- Food
- Pigment
- Wax
- Insecticide
- Mineral
- Plastic
- Metal
- Ceramic
- Pharmaceutical
- Carbon
- Chemical

"Jet-O-Mizing" produces **FINE PARTICLES** ¼ micron average and above **PLUS** . . . Narrow Particle Distribution • Dry, or Controlled Moisture Content • Continuous Operation • Uniformity of End Product • Other Operations with Grinding • No Attritional Heat — No Moving Parts • Low Operating Costs • Low Maintenance

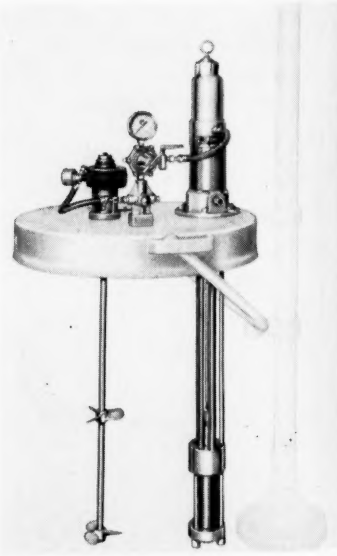
Send for complete information on Fluid Energy's "Jet-O-Mizer" Mills, "Jet-O-Clone" Dust Collectors, and TESTING AND CUSTOM GRINDING services.

FLUID ENERGY PROCESSING & EQUIPMENT COMPANY
Richmond & Norris Streets, Philadelphia 25, Pa. • Phone: Regent 9-7728
(Formerly known as the Wheeler-Stephanoff Mill)

enclosed hypocycloidal arrangement of gears to provide power transmission and capacity adjustment from zero to maximum flow. No exposed elements are needed to convert rotary drive motion to reciprocal pumping action.

A single unit with motor can drive one to four liquid ends, which may vary in size and materials of construction. Timing controls are available for single injection of a controlled volume of chemical during any given period from one second to eight days.

The pump may be driven by electric, rotary air or variable speed drives, does not need gear reduction. Capacity for solutions, slurries and liquefied gases is 1.8 to 1,472 gph., at pressures to 6,500 psi. Spring-loaded double-ball check valves provide metering accuracy of ±0.5% according to the manufacturer.—**Jaeco Pump Co., Villanova, Pa.** 254B



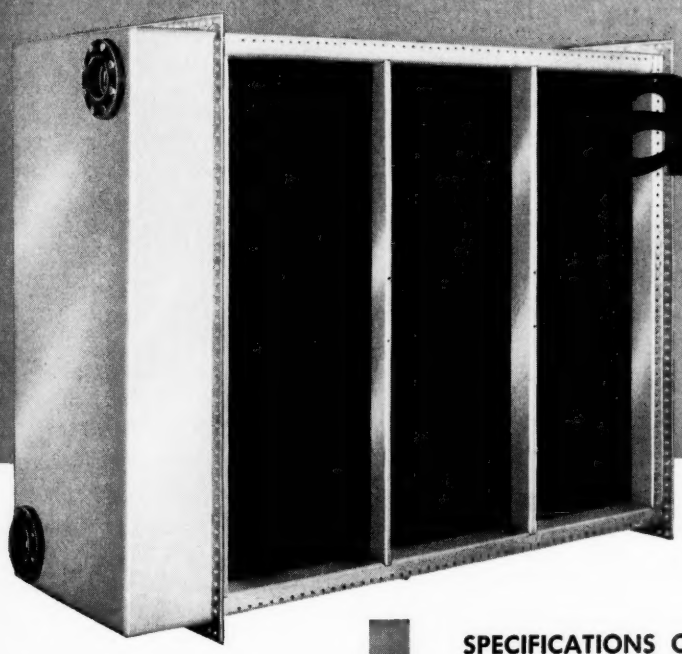
Drum pump

Stainless steel device empties 55-gal., open-top containers.

Light- or heavy-viscosity corrosive fluids are transferred from 55-gal. drums to storage or process with a stainless steel air-driven pump that comes with either a clamp or cover mounting.

Marlo

Liquid/Gas Heat Exchangers



any

APPLICATION, ALLOY, OR SIZE

Write or Phone for Additional Information for Your Application.

SPECIFICATIONS ON THIS UNIT:

MATERIAL: 316 ELC Stainless Steel
Face Dimensions: 60″ x 72″
Overall Dimensions: 98″ x 68″ x 30″

TUBES: 0.035″ wall, ⅝″ O.D.
Spacing: 1½″ center to center, staggered

FINS: 0.010″ plate type with die-formed ferrules
Spacing: 8 per inch

SURFACE: Total: 10,650 sq. ft.
Primary: 558 sq. ft.

CASING: Air tight at 60 inches W. G.

OPERATING PRESSURE: 1500 p.s.i.

WEIGHT: 5100 lb. dry

Marlo coil co.

SAINT LOUIS 11, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment Since 1925

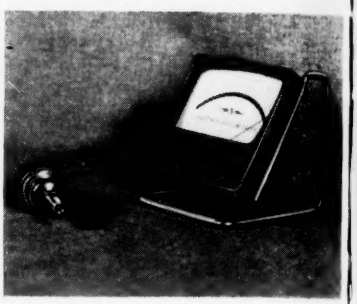
NEW BARTON 273 PNEUMATIC TRANSMITTER MEETS MORE APPLICATION REQUIREMENTS THAN ANY OTHER TRANSMITTER

The Barton 273 offers the widest differential pressure ranges (0-8" w.c. to 0-400 psi), the highest safe working pressures (to 10,000 psi), and the widest variety of housing materials (aluminum, brass, steel, 316 stainless steel). It's compact, weighing up to less than ½ the weight of other units. It has adjustable suppression up to 80% of DP range, and adjustable span. A non-bleed relay minimizes air consumption. It doesn't shift zero on overrange. It's unaffected by normal piping stress. In every respect, the Barton 273 is the most significant advance in pneumatic transmitters in the past decade. There's a lot more you should know about it—for complete data write

BARTON

INSTRUMENT CORPORATION, 580 MONTEREY PASS ROAD, MONTEREY PARK, CALIFORNIA.

The unit will deliver 1.75 gpm. continuously, with a maximum delivery rate of 2.5 gpm. Air consumption: 2 cu. ft./gal. of material pumped. For convenience in use, the unit is supplied with an optional pump elevator and material agitator.—**Binks Mfg. Co., Chicago.** 256A



Vacuum gage

Miniaturized circuitry is attached to rear of indicating meter

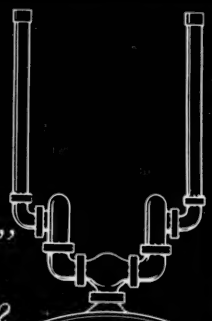
Miniaturization is featured in a vacuum gage that conveniently mounts on a panel board or equipment, or on a polished brass stand as shown. The self-contained transistorized circuitry is mounted directly to the rear of the indicating meter. Switching attachments are available to provide monitoring of up to five positions.

Operating on the thermopile principle, the unit provides three vacuum ranges from 0.2 micron through 20 mm. Hg. Matched interchangeable gage tubes, color-coded for each pressure range, incorporate ambient and rate-of-change ambient temperature compensation, will withstand shock, vibration and exposure to atmosphere. — **Hastings-Raydist, Inc., Hampton, Va.** 258A

Briefs

Molecular weight determinations roll out of a device that can handle a new sample every two minutes. Weights up to 5,000 are measured within 1%; to 20,000 with reduced accuracy. Samples

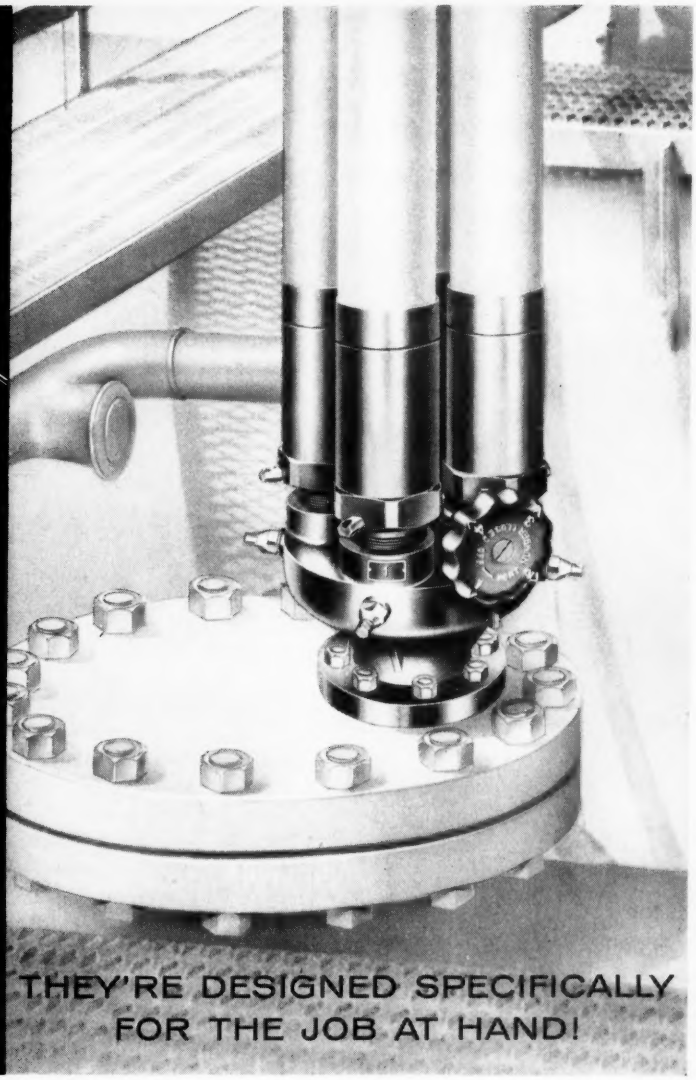
growing "cactus-plants" on your storage tanks?



investigate

REGO®

SAFETY RELIEF VALVE MANIFOLDS...



THEY'RE DESIGNED SPECIFICALLY FOR THE JOB AT HAND!

Cost far less to buy...far less to maintain.

RegO Safety Relief Valve Manifolds are specifically designed for continuous service on pressurized storage containers . . . designed to fit directly on a flanged opening with no need for inlet shutoff valves and piping which reduce ultimate relief capacity and require added maintenance . . . designed to save you money from first cost through the many long years of trouble-free operation. There is no need to evacuate the container, no complex dismantling necessary to remove, test and replace any of its safety relief valves. Direct labor time required for valve removal and replacement . . . 30 to 40 minutes.

"POP-ACTION" design of the safety relief valves keeps product loss to a minimum and assures utmost dependability. RegO Retest Service offers further savings in labor and inventory.

For complete details fill out the attached coupon and mail it today.

The BASTIAN-BLESSING Company

RegO Division
4201 West Peterson Avenue, Department 22-J
Chicago 46, Illinois

Please check type of service:

☐ Refinery ☐ LP-Gas ☐ Butadiene

☐ Anhydrous Ammonia ☐ _____

Name _____

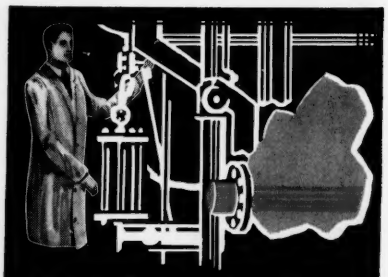
Company _____

Address _____

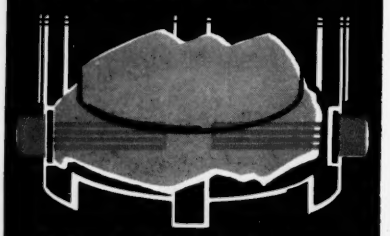
City _____ Zone _____ State _____

CHROMALOX
Flange-Type, Electric
IMMERSION HEATERS

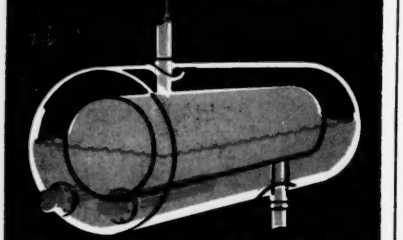
For hard-to-contain Liquids and Gases



Heat transfer fluid heated by electric heaters and pumped into adjacent kettle gives exact, controlled temperatures when used with a thermostat.



Heaters, mounted in jacketed kettles, give uniform, accurately controlled heat transfer for critical processing.



Insulated electric vapor kettle with self-contained heat transfer medium gives fast, uniform heat up to 700°F.

Chromalox Flange-Type Electric Immersion Heaters are quick, economical solutions to heating compressed air and other gases, for super-heating steam and for heating liquids of all types of heat transfer mediums.

They are ideal for high-temperature/high-pressure applications and for use in corrosive solutions. Chromalox Immersion Heaters provide exact temperatures and maintain these temperatures when used with thermostats. Standard heaters furnished with 150 psi flanges, special flanges withstand up to 4500 psi.

GET THE FACTS. See for yourself how Chromalox Immersion Heaters can help improve efficiency and/or decrease costs. Write for catalog 60.

WI-25

CHROMALOX
ELECTRIC HEAT
EDWIN L. WIEGAND COMPANY
7514 Thomas Blvd., Pittsburgh 8, Pa.

NEW EQUIPMENT . . .

may be 20 microliters or less. The unit measures temperature differences caused by differential mass transfer between the sample and a reference solvent.—**Mechrolab, Inc., Mountain View, Calif.** 258B

Thermistor probe is matched to enable it to be installed without calibrating the instrument, and for direct replacements to be made without calibration. Unit uses uncompensated lead wire for added convenience.—**Fenwal Inc., Ashland, Mass.** 260A

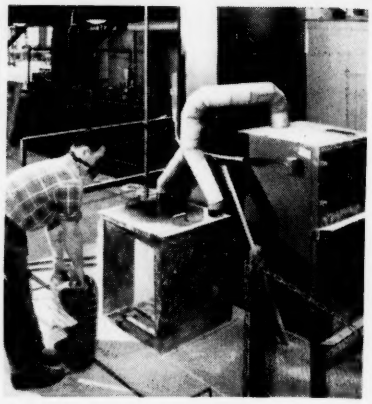
High-temperature paint, after a brief cure at 400-600 F., will survive temperatures to 2,500 F. and higher. Applied by brush or spraygun, paint has good heat-shock resistance, adheres well—often to the limit of the base metal.—**Tempil Corp., New York.** 260B

Spiral tubing is seamless flexible conduit of Teflon. For temperature range of −100 to +500 F., it serves for low-pressure flexible connections and various transfer and vent purposes.—**Resistoflex Corp., Roseland, N. J.** 260C

Equipment Cost Indexes . . .

	Mar. 1961	June 1961
Industry		
Avg. of all	237.2	236.9
Process Industries		
Cement mfg.	231.3	230.9
Chemical	238.0	237.3
Clay products	224.8	224.4
Glass mfg.	224.7	224.0
Paint mfg.	229.7	229.4
Paper mfg.	229.3	228.6
Petroleum ind.	234.7	234.8
Rubber ind.	237.6	237.6
Process ind. avg.	235.9	235.2
Related Industries		
Elec. Power equip.	237.9	235.1
Mining, milling	239.4	238.7
Refrigerating	268.5	268.6
Steam power	224.9	225.0

Compiled quarterly by Marshal land Stevens, Los Angeles, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124-6 for method of obtaining index numbers; Mar. 6, 1961, pp. 115-116 for annal averages since 1913.



track-transported elevator speeds chemical processing while

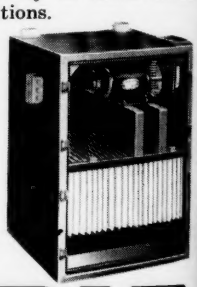
TORIT SOLVES DUST PROBLEMS

This ingenious centrifugal discharge elevator eliminates many man-hours of labor by servicing three reactors . . . and Torit rides along, picking up the dust from the operation. In this efficient process, bagged chemicals are dumped into the elevator's boot and automatically raised to a reactor. The elevator is then moved to the next reactor where the operation is repeated.

George A. Russell, the firm's chief engineer who initiated this system, says the "traveling" Torit Dust Collector rids the air of obnoxious chemical dust, helping maintain good working conditions. It simplifies housekeeping, and saves $250 per year in reclaimed chemicals. Efficiency of Torit filters allows recirculation of filtered air within the work area.

Anchem, whose principal products are Weedone liquid weed killers and metalworking chemicals, is the originator of 2,4D. Their use of the Torit cabinet model dust collector demonstrates the flexibility of these units for many applications.

Torit Dust Collectors may be just the ticket for your plant. They install anywhere—and they belong everywhere dust is a problem. For further information and for a free report on "Torit Filter Efficiency Tests on Fine Particulate Matter," write:



TORIT
MANUFACTURING COMPANY
1138 Rankin Street
St. Paul 16, Minnesota, Dept. 1138

See Torit Dust Collectors on display in Booth 1446 at the 28th Exposition of Chemical Industries, Nov. 27-Dec. 1, New York City.

USE THIS CONVENIENT ENVELOPE TO START RECEIVING YOUR PERSONAL SUBSCRIPTION NOW!

THE NEXT 78 BIWEEKLY ISSUES FOR ONLY $5.00

NEW SUBSCRIPTION APPLICATION

☐ 3 years of CHEMICAL ENGINEERING for $5

Foreign 1 Yr.: Canada $4
West. Hem. $15 • Others $25

☐ ✓ HERE for 1 YEAR @ $3

☐ Bill me
☐ Bill my company
☐ Payment enclosed

Please Print

Name_____ Title_____

Home Address_____

City_____ Zone_____ State_____

Company & Department_____ Approx. No. of Employees in Plant_____

☐ Manufacturer
☐ Wholesaler

Product(s)_____

K

M

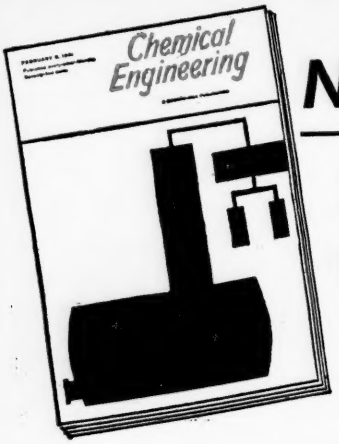
BUSINESS ADDRESS

10-16-61

Street_____ City_____ Zone_____ State_____

☐ Check here if you want publication sent to business address

Subscriptions Accepted Only From CPI Engineers, Technical Management and Senior Students. Cards Must be Filled-In Completely Before Service Starts -- Students Please Include Class, Major Field and School.



NOW...

3 YEARS FOR ONLY $5.00

FILL IN OTHER SIDE AND RETURN POSTAGE-FREE ENVELOPE TODAY

Tear off along dotted line, fold down and seal.
This is a complete return envelope already addressed and needs no stamp.

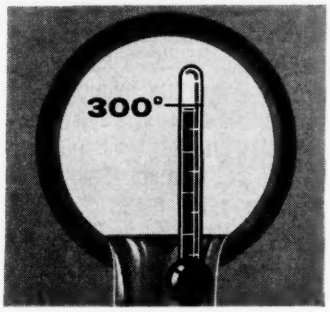
FIRST CLASS
Permit No. 64
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

Chemical Engineering

330 WEST 42nd STREET
NEW YORK 36, N. Y.



PROTECTION . . . THAT REALLY WORKS!

If you've ever had a pipe deteriorate, you know how serious it can be. Fibercast stands up where others simply won't do. Produced under a carefully controlled manufacturing process, its solid centrifugally cast walls provide positive protection against high temperatures in corrosive environments.

FIBERCAST® epoxy pipe safely handles corrosive solutions to 300° temperatures

Rugged pipe carries 94% of known corrosive solutions. Available now in sizes from 2" to 8"

Heat and corrosion failures cost money. That's why it's important to consider the maximum protection you get with Fibercast epoxy pipe. Protection against premature fouling, generally attributed to operating temperatures and corrosive solutions. Protection against intermittent replacements, downtime—added costs for new materials and labor.

Years of actual operation in field use, prove Fibercast outlasts other kinds of pipe. Even more expensive metal pipe, or pipe with thermoplastic interior coatings cannot match Fibercast's resin rich interior.

Comparative Life Data

Report after report shows that Fibercast does outperform other types of pipe in terms of long service life. Basing Fibercast Grade J at 100% as unit life, comparable ratings show: Aluminum, 26%. Brass (RED), 74%. Rubber Hose, 21%. Stainless Steel (304-40), 31.1% Asbestos (cement C-100), 23.7%.

Handles 94% of Known Corrosive Chemical Solutions

Out of 338 common corrosive solutions, Fibercast safely handles 320. Not only does it provide superior resistance to corrosion, heat and pressure—it also has the outstanding ability to maintain the purity of the solutions it carries. The pipe has a glass-smooth interior with a Hazen-Williams C-Flow Factor of 147. This cuts friction losses. Encourages flow at intended pressures. Resists deposit build-up. Dielectric properties ward off electrolytic action.

Fibercast owes its long life—and its special resistance to heat, pressure, corrosion, contamination, electrolytic action—to the exclusive way it is built. Fibercast is a centrifugally cast thermoset epoxy resin reinforced pipe with multiple layers of seamless braided glass fiber sleeving or especially woven glass fabric. Its body of woven glass fibers, impregnated with epoxy resin chemically cured at elevated temperatures provides remarkable ability to withstand high pressure and temperature in corrosive environments.

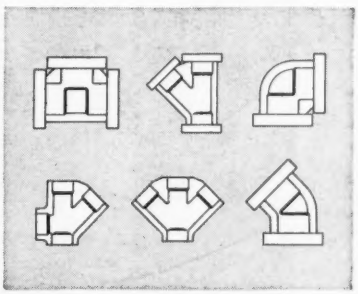
FIELD USE PROVES RESISTANCE TO CORROSION . . . 1 Plastic-coated steel nipple (right), used in salt water supply well, corroded and lost strength after 3 months. Fibercast (left), used in same installation for 3 years still shows no loss of strength.

Savings Right from the Start

Fibercast puts you way ahead for your money from time of installation. Light weight makes it easy to handle; (it is one-fourth the weight of steel). Yet it even has structural stability and strength for installation on span racks with the normal metal pipe spacing.

Complete Line of Fittings

Fibercast offers fittings to solve any fitting problem. Besides a vast stock of standard sizes and types, Fibercast also designs and makes special fitting to meet individual problems. All have the same corrosion resistance properties of Fibercast Pipe and Tubing.



Get the full story on Fibercast Pipe, Tubing and Fittings. Find out how they can help you solve and combat specific problems relating to temperature, pressure and corrosion. Mail coupon today.

FIBERCAST COMPANY, Dept CE-101
Box 727, Sand Springs, Oklahoma
Please send me, without obligation, further details about Fibercast Pipe, Tubing and Fittings.

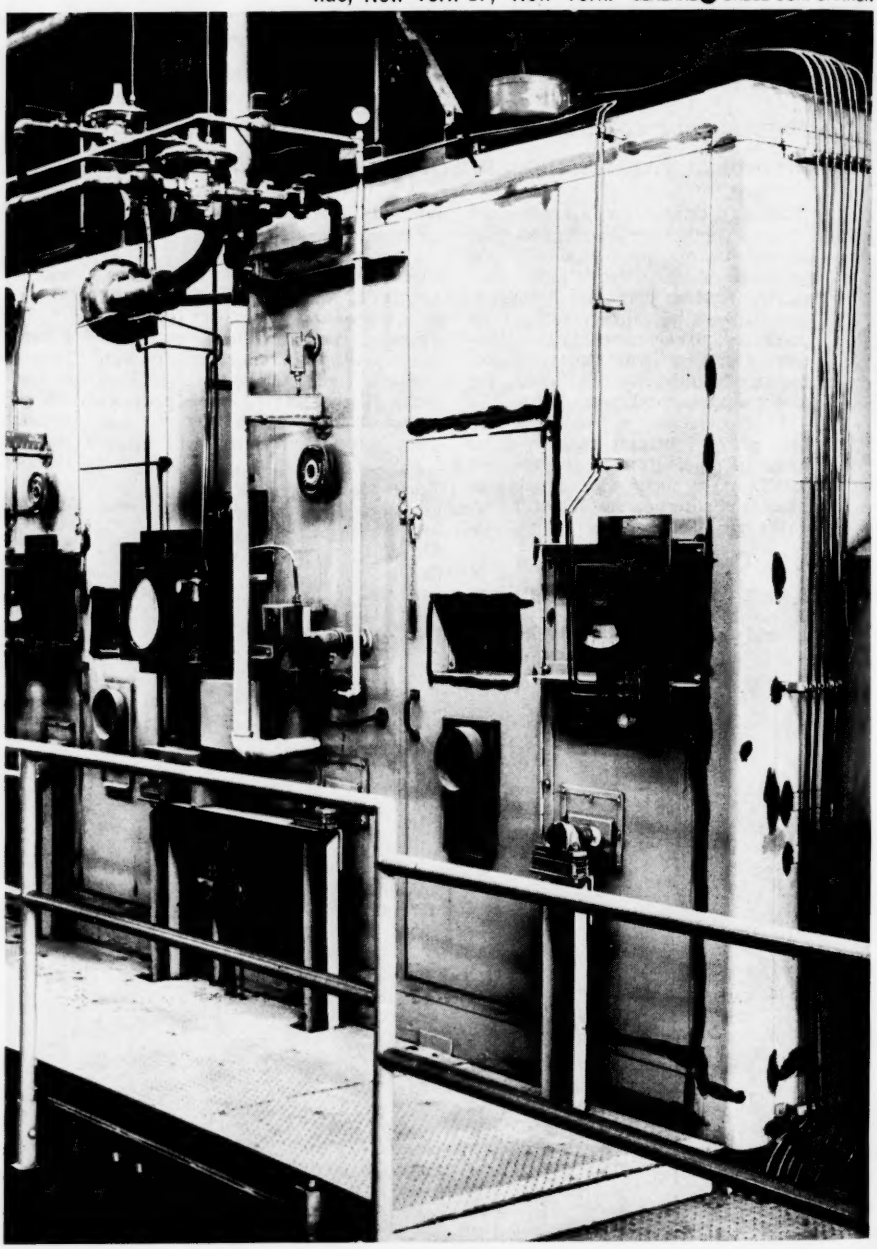
Name _____
Address _____
Title _____
Firm _____
Type of Business _____
City _____ Zone _____ State _____

FIBERCAST® COMPANY
A DIVISION OF **Youngstown** SHEET AND TUBE COMPANY

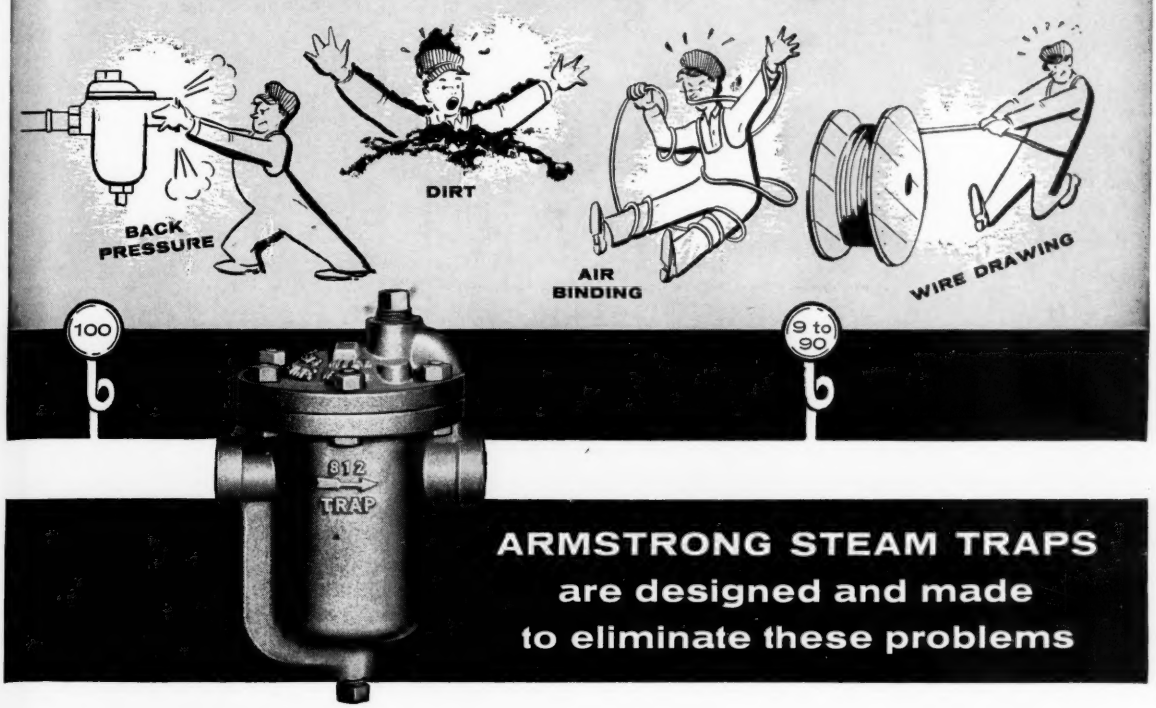
SMOOTH SMOKING THANKS TO MI CABLE

Mineral Insulated Cable performs reliably, even under high temperatures and 100% humidity. That's why King Edward Cigar Co., Jacksonville, Fla.,—world's largest cigar manufacturer under one roof—chose MI Cable for their new process equipment. Around this oven and dryer assembly, for instance, MI is subjected to high temperatures; MI lines under the walkway, and to sump pump motors are usually wet as moisture is driven out of the oven. In spite of such punishment, MI Cable continues to perform. Mineral Insulated Cable is approved for hazardous use by the NEC. Solve your heat and humidity electrical problems with Mineral Insulated Cable. Write for MI catalog S-2. General Cable Corporation, 730 Third Avenue, New York 17, New York.

GCC
GENERAL CABLE CORPORATION



Have you ever been troubled by any of these steam trap problems?



ARMSTRONG STEAM TRAPS are designed and made to eliminate these problems

BACK PRESSURE . . . Armstrong Traps operate on any back pressure—or vacuum, for that matter. As long as there is a pressure differential across the trap, it will close on steam and open for condensate. Even the high back pressure caused by blow through of one or more traps in the system will not disturb Armstrong Traps. Other than a reduction in capacity, Armstrong Traps are unaffected by back pressure.

DIRT . . . Armstrong Traps are not affected by ordinary dirt. When the trap opens condensate swirls down under the edge of the bucket and up through the discharge orifice. Dirt is kept in suspension and discharged along with the condensate. For very bad dirt conditions, Armstrong offers traps with integral strainers. These cost less than a trap plus a separate strainer.

AIR BINDING . . . Armstrong Traps cannot air bind. Air in the system passes through a vent in the top of the bucket. It collects in the top of the trap and is discharged with the condensate. There is no chance for it to stop the trap. For low pressure on-and-off units where large amounts of air accumulate while the steam is off, Armstrong offers open float and thermostatic air vent traps in a complete range of sizes.

WIRE DRAWING . . . Armstrong Traps are designed and made to resist wire drawing. The valve and seat are tough stainless steel. The valve opens and closes tightly with a fast action and is always water sealed. There is virtually no chance for grit or sediment to lodge in the valve, virtually no chance to create conditions that lead to wire drawing.

There's no need to accept any of these problems as "inevitable." Your local Armstrong Representative can show you how to end them all. Call him today or write direct.

860 Series for low pressure heating service.

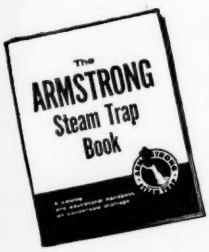
800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.

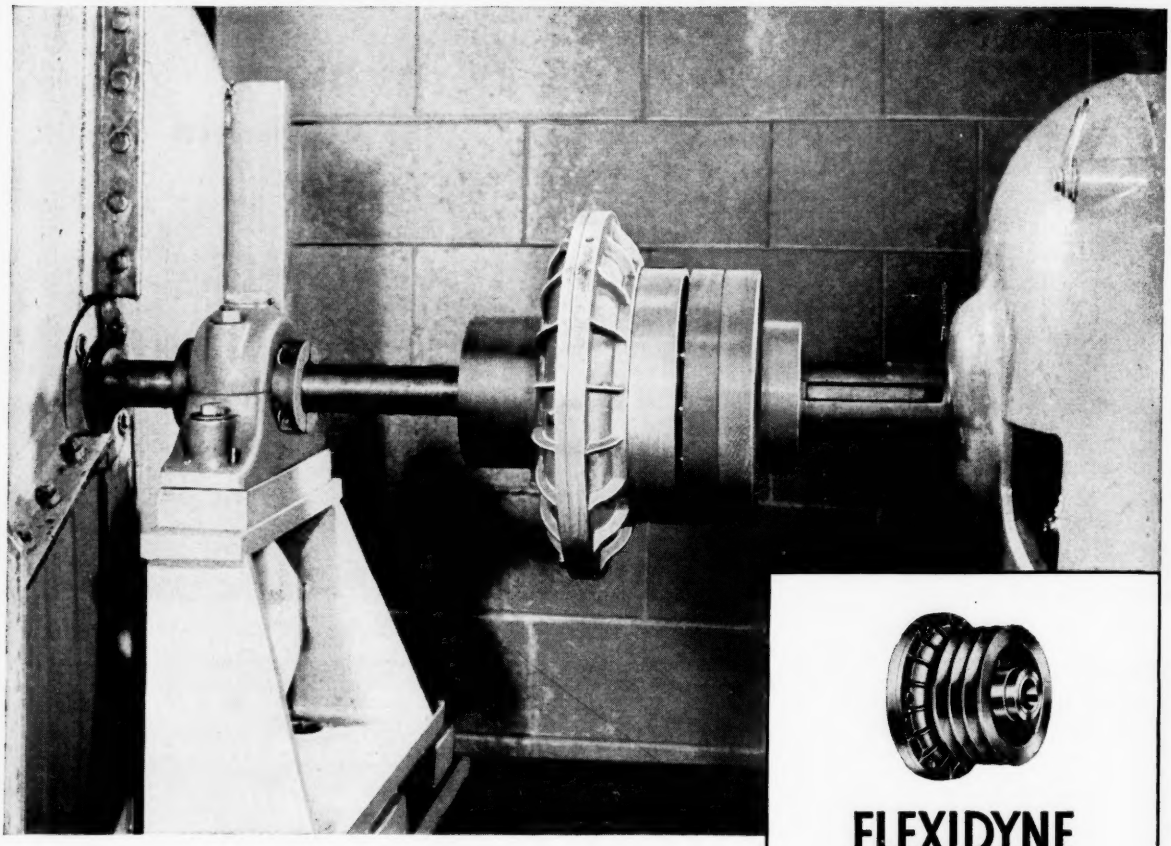


The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

ARMSTRONG MACHINE WORKS

8581 MAPLE STREET, THREE RIVERS, MICHIGAN

"SEE OUR CATALOG IN CHEMICAL ENGINEERING CATALOG"

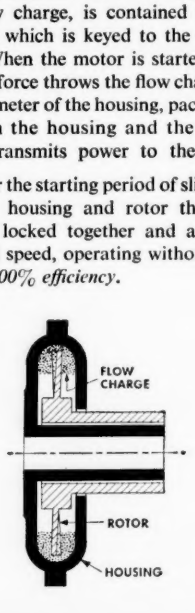


FLEXIDYNE

THE DRY FLUID DRIVE

The "fluid" in Flexidyne is heat treated steel shot. A measured amount, called the flow charge, is contained in the housing which is keyed to the motor shaft. When the motor is started centrifugal force throws the flow charge to the perimeter of the housing, packing it between the housing and the rotor which transmits power to the load.

After the starting period of slippage between housing and rotor the two become locked together and achieve full load speed, operating without slip and at *100% efficiency*.



Look, Folks...No Jolts!

– and no reduced voltage starter!

– no oversize motor!

Introduce Flexidyne into your drive system and your stubborn loads take off smoothly, without the necessity of oversize motors or costly controls. Flexidyne provides the equivalent of a "no load" start, reduces maintenance, protects motors against shock or overload, and operates at 100% efficiency at full load speed!

Across the nation — on blowers, shears, mixers, agitators, chippers, ball mills, cranes, conveyors, cotton cards, jaw crushers, *everywhere* — thousands of Flexidynes are performing brilliantly. Here is the *new and better way* to start loads smoothly!

Flexidyne is available from stock in 8 drive sizes and 10 coupling sizes for capacities to 1000 hp. Ask your Dodge Distributor, or write us for complete technical bulletin.

Dodge Manufacturing Corporation, 200 Union St., Mishawaka, Indiana

The Products with the Pluses... **DODGE** ***of Mishawaka, Ind.***

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Look under "Dodge Transmissioneer" in the *white* pages of your phone book. Factory trained by Dodge, he can give you valuable assistance.

Technical Bookshelf

HOT BUT HANDLED

MANAGEMENT OF NUCLEAR MATERIALS. ED. BY R. F. LUMB. VAN NOSTRAND. 516 PAGES. $16.50.

Reviewed by E. D. Marshall, Chief, Nuclear Materials Control Branch, Oak Ridge Operations Office, U. S. Atomic Energy Commission.

The primary objective of accumulating the basic philosophies and implementing practices developed over a period of 13 years by the Atomic Energy Commission and its prime contractors in handling nuclear materials of intrinsically high monetary value has been achieved here.

The book serves admirably as a reference of workable nuclear-management policies, as well as a history of the AEC materials-control program. It would be useful at the management and field supervisory level of any plant undertaking processing of nuclear materials, whether as a licensee of or under contract to the AEC.

The presentation is kept sufficiently general by including examples from each major AEC program, while retaining enough specifics from each process to give the reader a reliable picture of the problems that would be encountered were his process limited to only fuel element fabrication, recovery of scrap, or reduction of compounds to metal.

The need for contributions from a variety of professional disciplines in an effective nuclear-materials management program is made clearly evident. The chemical engineer, physicist, chemist, reactor technologist, statistician, accountant or auditor will find his specialty represented, and not merely mentioned in passing. While this characteristic need for a working knowledge on a broad professional front may be disconcerting to the newcomer in this field, it is a reality that is not overemphasized in the book.

Some difficulty may be expected in scaling down the procedures covered to less-grandiose processes than those undertaken by the AEC. But this difficulty is minimized by explaining the necessity for certain records, measurements, or procedures.

Lumb adequately illustrates the need for, and demonstrates the practical accomplishment of, a material-management system that is unobtrusively woven into the operating organization—as distinguished from a system that is superimposed as an additional burden on production and research.

RESERVATION ON OPTIMIZATION

THE OPTIMAL DESIGN OF CHEMICAL REACTORS. BY R. ARIS. ACADEMIC PRESS. 191 PAGES. $7.

Reviewed by D. N. Miller, E. I. du Pont de Nemours & Co., Wilmington, Del.

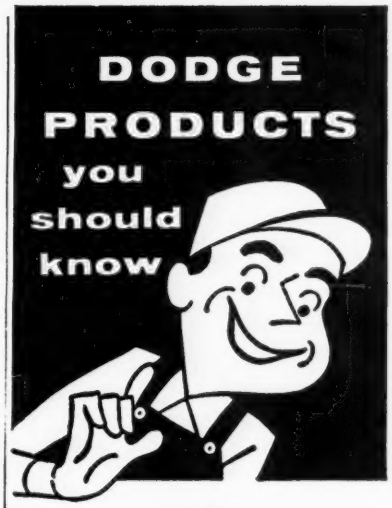
Along with the development of high-speed computers in recent years, has come an increasing interest in optimization techniques. Reaction systems, being the core of chemical manufacturing processes, have a high economic potential associated with their proper design and operation. The optimizers have justifiably given particular attention to this field.

In his calculations, the author has incorporated the "principle of optimality," which was first introduced by Richard Bellman in his recent book on "Dynamic Programming." This is a systematic procedure whereby the number of calculations needed to define an optimum condition can be minimized. The approach is particularly well-suited to digital computation.

Examples of optimization calculations are given for several types of reactors, including: batch, tubular, multibed adiabatic reactors and continuous-flow stirred tanks. Reviews of other published reactor optimization studies are tied in nicely with these examples.

There is also an interesting chapter on problems in which only statistical information is available on some important characteristic of performance. The example on developing optimal catalyst replacement policy will be of particular interest to operations people.

The author takes the usual point



TORQUE-ARM

America's most widely used shaft mounted speed reducers!

DODGE PARA-FLEX

The Flexible Cushion Coupling

with the 4-way flex!

DIAMOND D CLUTCHES

Rugged! Compact! Completely enclosed!

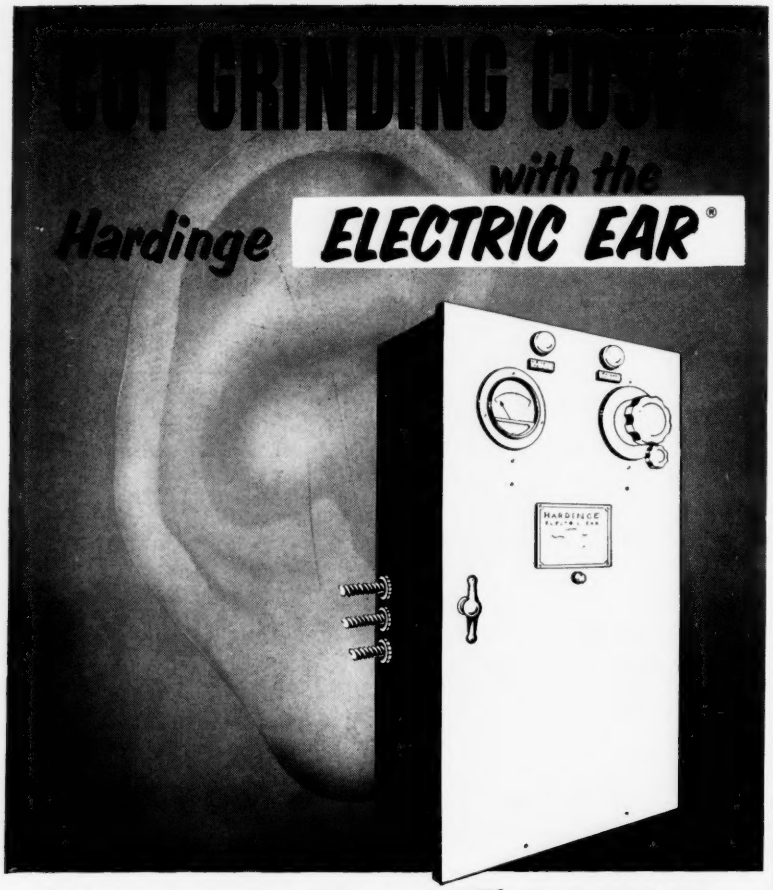
•

Write for Bulletins!

- ✓ Torque-Arm—55 models—complete data.
- ✓ Para-flex Couplings—data.
- ✓ Diamond D Clutches—technical data.

DODGE MANUFACTURING CORPORATION
200 Union Street • Mishawaka, Indiana

DODGE
of Mishawaka, Ind.



Users report 10 to 15% INCREASE in their GRINDING MILL CAPACITY

In a recent survey of Hardinge Electric Ear® users, many of them reported 10% to 15% increased grinding mill capacity after installing an Electric Ear.® This unit controls the mill feed, based upon grinding sound level, to produce optimum grinding conditions.

Here are a few typical statements from satisfied customers:

"This unit is doing a remarkable job. It reduces steel and liner consumption. We estimate a savings, with our two units, of $6000 per year on grinding balls and liners. Capacity gained 10%."

"Approximately 25% gain in capacity."

"Helps prevent plug-ups."

"Maintains uniform mill load. Estimated gain in capacity 10%."

"We feel this unit is essential to our operation from a proper quality control standpoint. We would not be able to keep up our present rate of accelerated production and quality without it."

"Electric Ear® is helpful when inexperienced grinders are learning to operate the mills."

"Eliminates human element in mill feed level."

"Savings per year — $10,000.00."

"Principal reason for Electric Ear® use is that it aids the operator, and the mill can be operated from a remote panel."

Write for Hardinge Catalog No. 42-A-11.

HARDINGE
COMPANY, INCORPORATED
Main Office and Works • 240 Arch St., York, Pa.

NEW YORK
TORONTO
CHICAGO
HIBBING
SALT LAKE CITY
SAN FRANCISCO
HOUSTON
LAKELAND
BIRMINGHAM

"Hardinge Equipment—Built Better to Last Longer."

of departure in his optimization calculations, whereby it is generally assumed that kinetics, adsorption, mass transfer, mixing, bypassing, etc., are all well-known effects and that they are expressible in abbreviated mathematical form. These are put into mass-and-energy balances (with suitable boundary conditions) and solutions are obtained maximizing some property or "objective function" of the reacting system.

The unfortunate truth is that systems in which all the chemical and physical parameters are well-defined are hard to come by. This reviewer has yet to encounter one. In most cases, significant improvements remain possible through an increased knowledge of basic mechanisms. It seems likely that, balanced against formalized optimization procedures, equivalent effort expended along these lines has the greater potential for economic gain.

BACKGROUND AND REVIEW

CRYSTALLIZATION. BY J. W. MULLIN, BUTTERWORTHS, LONDON. 268 PAGES. $11.

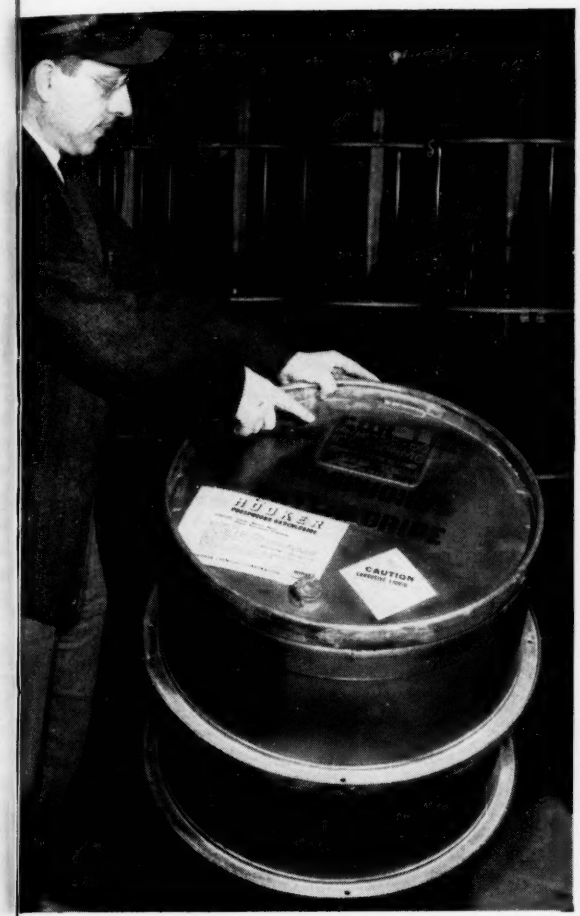
Reviewed by Donald E. Garrett, Associated Chemicals Co., Pomona, Calif.

Though many excellent articles and symposia have recently been presented on the subject of crystallization, there is no single up-to-date reference in the field. This work fills at least part of the gap.

In attempting to outline the more important aspects of crystallization theory and practice, the book takes on a very wide scope. Considerable attention is given to the physical chemistry pertinent to crystallization, both as to general principles and as it applies to practice.

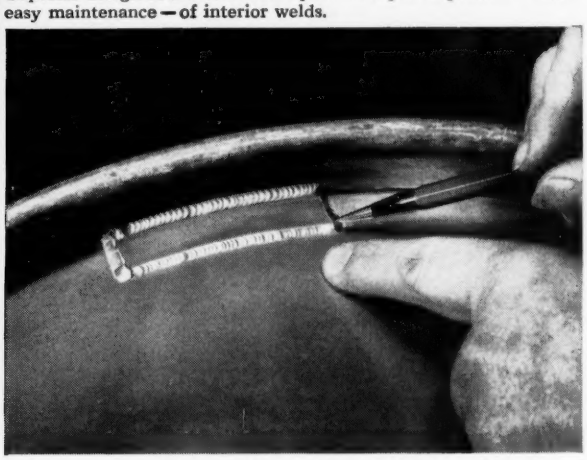
Many references are given on this aspect, as they are throughout. Probably they comprise the book's strongest feature, for most of the important literature pertaining to crystallization is reviewed and listed.

The major theories and fundamental studies on nucleation and crystal growth are summarized, and a detailed review is made of dif-



Hooker Chemical Corporation uses Benson's Nickel 200 drums for handling corrosive chlorides. Drum head is dished for strength. Holes in rolling hoops are for drainage.

Superior design of Benson drums permits rapid inspection — and easy maintenance — of interior welds.



Note excellent welding quality on Nickel 200 tab attachment to end chime inside ring. Slot between head and ring permits head drainage during outdoor storage.

Nickel 200 puts years of service life into drums handling chlorides and other corrosive chemicals

It's a major test for metals when they're used in 55-gallon drums for the shipment of phosphorous oxychloride, benzoyl chloride, sulfuryl chloride and other highly corrosive chemicals. The drums also have to withstand the roughest sort of handling, yet not be so heavy that they are cumbersome and expensive to ship.

The Benson Manufacturing Company of Kansas City, Missouri relies on wrought Nickel 200 (formerly designated "A" Nickel*) for drums that have to meet these requirements. The strength and corrosion resistance of Nickel 200 prevents cracking, flexing and leaking... and reduces the possibility of product contamination or discoloration. Nickel 200 drums fabricated for Hooker Chemicals Corporation, Niagara Falls, New York, have an average life expectancy of around 17 years, two to three times the life of other materials previously used for this type of service.

Readily fabricated Nickel 200 permits a superior drum design that is easy to clean and maintain — a design which takes advantage of the good strength-to-weight ratio of Nickel 200 to keep the weight of the drum at a reasonable level. These drums fabricated of Nickel 200 alloy will withstand a hydrostatic pressure test of 80 psi and a 6-foot drop test (at 830 lbs full) to solid concrete with no leakage.

The good weldability of Nickel 200 permits welds that are non-porous, smooth, and free from splatter, shrink holes and undercuts.

Wrought Nickel 200 may very well provide a practical answer to your chemicals-handling problems. It's available in all the common mill forms and its good welding and fabrication characteristics offer important manufacturing economies.

Write for more information on drums fabricated from Nickel 200 and a copy of the informative booklet "Engineering Properties of Nickel."

*A new folder available on request, lists all of the alloys available from the Huntington Division; gives data on the chemical composition of these alloys.

HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
Huntington 17 West Virginia

INCO

HUNTINGTON ALLOYS

New DAY "RJ" Dust Filter

CONTROLS DUST SAVES DOLLARS

only 3 moving parts

Built under patents of The DAY Company and H. J. Hersey, Jr.

Because of its new, simplified design the DAY "RJ" dust filter will save you many dollars on initial investment, installation, operation and maintenance. Some of the important new construction features of this dust filter are: a new, quick-opening reverse-air, counter-flow valve for maintaining filter media porosity; a new, reverse-air pressure blower arrangement, and new, air tight, yet quickly opened inspection doors.

This patented DAY dust filter has only 3 moving parts but controls dust effectively, efficiently (99.99+%) and economically. It represents the latest refinement in a long-tested, plant-proven dust filter. Using felted filter sleeves to capture dust, the "RJ" is now available in 5 sizes for handling from 300 to 6400 CFM of air (for larger capacities, multiple groupings are furnished).

For more detailed information write toDAY for free Bulletin G-30. It's filled with facts, specifications and dimensions.

The DAY Company

SOLD in UNITED STATES by
The DAY SALES Company
856 Third Avenue N.E.
Minneapolis 13, Minnesota
FEderal 6-9671

MADE and SOLD in CANADA by
The DAY Company of Canada Limited
Rexdale (Toronto), Ontario, Canada
Fort William, Ontario, Canada
Rexdale, Cherry 1-8589

Representatives in Principal Cities

EXPERIENCE ENGINEERED . . . LABORATORY TESTED . . . PLANT PROVEN

Dust Control • Pneumatic Conveying • Bulk Storage

EQUIPMENT . . . SYSTEMS . . . INSTALLATION

ferent methods of crystallization (sublimation, adduct formation, etc.). Examples are given of many different industrial crystallization applications, and a large number of crystallizers from both the present and the past are discussed.

Unfortunately, it is this last area that receives the poorest coverage. Crystallizers are discussed from an almost historical, review-of-the-literature standpoint, with little effort to critically differentiate among the various types of equipment and point out important design features. Almost no attention is given to the methods of crystallizer design and to the principles and techniques that have led to such significant improvement in this unit operation during the past ten years.

As a result, this book that presents such excellent coverage in so many respects, still cannot be considered a real "working" addition to the chemical engineers' literature, but rather an interesting background and review book.

In Rapid Review

Metals Handbook. 8th ed.; vol. 1—properties and selection of metals. Ed. by T. Lyman. American Society for Metals, Metals Park, Novelty, Ohio. 1,300 pages. $30. An enormous quantity of data on metals selection and use is presented, conveniently broken down by metal type. Covered are steels, stainless steels, cast irons, tool materials, magnetic and special-purpose materials, aluminum, copper, lead, magnesium, nickel, tin, titanium, and their alloys; and precious metals. Data are given on properties and processing, together with selection criteria. A 63-page index directs the reader to the required information.

More New Books

A Patent Manual for Scientists and Engineers. By G. M. Naimark. Charles C. Thomas, Publisher, Springfield, Ill. 108 pages. $5.50.

Heat Transfer Calculations by Finite Differences. By G. M. Dusinberre. International Textbook Co., Scranton 15, Pa. 293 pages. $12.75.

Rules and Methods for Calculating the Physico-Chemical Properties of Paraffinic Hydrocarbons. By V. M. Tatenskii, V. A. Benderskii, S. S. Yarovoi. Pergamon. 128 pages. $5.50.

FOR MORE INFORMATION

- Advertised Products
- New Equipment
- New Chemicals
- Manufacturers' Literature
- Classified Advertisements

Also . . .
- Reprint orders
- Subscriptions

Your Reader Service card is fastest.

USE EITHER CARD

They're easy to fold and tear out . . . try it . . .

PLEASE PRINT *

NAME:
TITLE:
COMPANY:
NO. OF EMPLOYEES:
PRODUCT:
ADDRESS:
CITY, STATE:

FIRST CLASS
PERMIT NO. 64
(Sec. 34.9 P.L.&R.)
NEW YORK, N. Y.

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

—POSTAGE WILL BE PAID BY—

Chemical Engineering
READER SERVICE DEPARTMENT
330 West 42nd St.
NEW YORK 36, N. Y.

PLEASE PRINT *

NAME:
TITLE:
COMPANY:
NO. OF EMPLOYEES:
PRODUCT:
ADDRESS:
CITY, STATE:

FIRST CLASS
PERMIT NO. 64
(Sec. 34.9 P.L.&R.)
NEW YORK, N. Y.

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

—POSTAGE WILL BE PAID BY—

Chemical Engineering
READER SERVICE DEPARTMENT
330 West 42nd St.
NEW YORK 36, N. Y.

Help Yourself . . .

The postcards above can now bring you technical help, latest literature, expert guidance. Tear one out and, as you read this issue, circle numbers when you want more information. You'll note that the coding system is simple: all the code numbers are page numbers.

You can also use these post-paid cards to subscribe, or to make your selection from a comprehensive list of editorial reprints.

* **Be sure to fill in all of these address blanks before mailing postcard.**

CIRCLE code numbers for more information. (This Oct. 16, issue card will expire Jan. 16, 1962)

Cover	33-34	59	74b	110A	118C	135	158	221c	241b	254A	265b	277c	289B	TL299
1	35	60	74c	110B	118D	136	159	221d	241c	254B	265c	277d	L290	BL299
2	36-37	61a	75	110C	118E	137	163	223	242	TL255	266	277A	R290	R299
4	38-39	61b	76	110D	119	138	164	225	243	BL255	267a	L278	L291	L300
6	40-41	61c	77	111	120A	139	165	227	244	R255	267b	R278	R291	TR300
8-9	42-43	62	78	112A	120B	140	166	228	245	256	268	279	L292	BR300
10-11	44-45	63	79	112B	120C	141	201	229	246	256A	272	280	R292	310
12-13	46-47	64	80	113	120D	142	203a	230	247	257	272A	280A	293	311
14-15	48-49a	65a	81	114A	121	143	203b	231	248	258	273	280B	293A	312
16-17	48-49b	65b	82	114B	122	144	203c	232	248A	258A	273A	280C	L294a	TL313
18-19a	48-49c	66	83	114C	123	145	203d	233	249	258B	273B	281A	L294b	BL313
18-19b	48-49d	67	84	114D	124	147	203e	234	249A	259	L274	282	R294	R313
18-19c	48-49e	68	86	114E	125-126	148	205	235	249B	L260	TR274	TL283	295	TR314
18-19d	51-52a	69	91	114F	127	149	207	236	250	R260	BR274	BL283	295A	BR314
20-21	51-52b	70	93	115	128	150	209	237	250A	260A	275a	R283	L296	315
22-23	51-52c	71	97	116A	129a	151	211	238	251	260B	275b	284	TR296	316
24-25a	51-52d	72a	99	116B	129b	152	213	239	252	260C	275c	285A	BR296	TC317
24-25b	51-52e	72b	101	116C	130	153	215	240a	252A	261	275A	R286	297	BL317
24-25c	53	72c	103	116D	131	154	217	240b	252B	262	275B	287A	297A	R317
26-27	54-55	72d	105	117	132	155	219	240c	253	263	275C	L288	298	318
28-29	56-57	73	107	118A	133	156	221a	240d	253A	264	277a	R288	298A	319
30-31	58	74a	109	118B	134	157	221b	241a	254	265a	277b	289A	298B	320
32														

CIRCLE KEY NUMBERS for more information about . . .

- **ADS**
- **PRODUCTS** page 110
- **EQUIPMENT** page 116
- **SERVICES**
- **LITERATURE** page 272

- **CLASSIFIED**

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

REPRINTS: Circle what you want. (See opposite page for description)

40	42	45	49	50	52	54	57	59	61	62	63	64	66	67	68	70	72	73	74	75	76
79	80	81	82	83	85	86	87	88	89	90	91	92	94	97	98	99	100	101	102	103	105
107	108	109	110	111	112	113	114	115	117	119	120	121	122	123	124	125	126	127	129	130	131
133	135	136	138	139	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157
158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179
180	181	182	183	184	185	186	187	188	189	190	191										

REPRINTS (While they last)

FREE REPRINT: Check here ☐ for your file copy of this issue's free reprint. (p. 210) FC 73

Send CE for ☐ 1 yr. $3, ☐ 3 yr. at $5 (U.S. rate only.) To _____ 21

CIRCLE code numbers for more information. (This Oct. 16, issue card will expire Jan. 16, 1962)

Cover	33-34	59	74b	110A	118C	135	158	221c	241b	254A	265b	277c	289B	TL299
1	35	60	74c	110B	118D	136	159	221d	241c	254B	265c	277d	L290	BL299
2	36-37	61a	75	110C	118E	137	163	223	242	TL255	266	277A	R290	R299
4	38-39	61b	76	110D	119	138	164	225	243	BL255	267a	L278	L291	L300
6	40-41	61c	77	111	120A	139	165	227	244	R255	267b	R278	R291	TR300
8-9	42-43	62	78	112A	120B	140	166	228	245	256	268	279	L292	BR300
10-11	44-45	63	79	112B	120C	141	201	229	246	256A	272	280	R292	310
12-13	46-47	64	80	113	120D	142	203a	230	247	257	272A	280A	293	311
14-15	48-49a	65a	81	114A	121	143	203b	231	248	258	273	280B	293A	312
16-17	48-49b	65b	82	114B	122	144	203c	232	248A	258A	273A	280C	L294a	TL313
18-19a	48-49c	66	83	114C	123	145	203d	233	249	258B	273B	281A	L294b	BL313
18-19b	48-49d	67	84	114D	124	147	203e	234	249A	259	L274	282	R294	R313
18-19c	48-49e	68	86	114E	125-126	148	205	235	249B	L260	TR274	TL283	295	TR314
18-19d	51-52a	69	91	114F	127	149	207	236	250	R260	BR274	BL283	295A	BR314
20-21	51-52b	70	93	115	128	150	209	237	250A	260A	275a	R283	L296	315
22-23	51-52c	71	97	116A	129a	151	211	238	251	260B	275b	284	TR296	316
24-25a	51-52d	72a	99	116B	129b	152	213	239	252	260C	275c	285A	BR296	TC317
24-25b	51-52e	72b	101	116C	130	153	215	240a	252A	261	275A	R286	297	BL317
24-25c	53	72c	103	116D	131	154	217	240b	252B	262	275B	287A	297A	R317
26-27	54-55	72d	105	117	132	155	219	240c	253	263	275C	L288	298	318
28-29	56-57	73	107	118A	133	156	221a	240d	253A	264	277a	R288	298A	319
30-31	58	74a	109	118B	134	157	221b	241a	254	265a	277b	289A	298B	320
32														

CIRCLE KEY NUMBERS for more information about . . . ● ADS ● PRODUCTS page 110 ● EQUIPMENT page 116 ● SERVICES ● LITERATURE page 272

● CLASSIFIED

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

REPRINTS: Circle what you want. (See opposite page for description)

40	42	45	49	50	52	54	57	59	61	62	63	64	66	67	68	70	72	73	74	75	76
79	80	81	82	83	85	86	87	88	89	90	91	92	94	97	98	99	100	101	102	103	105
107	108	109	110	111	112	113	114	115	117	119	120	121	122	123	124	125	126	127	129	130	131
133	135	136	138	139	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157
158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179
180	181	182	183	184	185	186	187	188	189	190	191										

REPRINTS (While they last)

FREE REPRINT: Check here ☐ for your file copy of this issue's free reprint. (p. 210) FC 73

Send CE for ☐ 1 yr. $3, ☐ 3 yr. at $5 (U.S. rate only.) To _____ 21

For Subscriptions: To apply, check here..... (Pay when billed) Where to send subscriptions.....

Want More Data?

Important—Code numbers are page numbers and for pages showing more than one advertised item, use this guide to numbers on cards above.

Use either of these two postcards for catalogs . . . for more information on equipment . . . on materials . . . on advertised items . . . for helpful reprints of editorial articles. Be sure to fill out the other side of cards.

18-19a—Introduction to Heating Mantles
18-19b—Laboratory-Type Heating Mantles
18-19c—Industrial-Scale Heating Mantles
18-19d—Mantles For Special Applications
24-25a—Mass Flowmeter
24-25b—Null Balance Recorders
24-25c—Telemetering Systems
51-52a—Formaldehyde, Stabilized
51-52b—Formcel Solutions
51-52d—Trioxane
51-52e—1, 3-Butylene Glycol
72a—Pumps, All-Chem
72b—Centri-Chem Pumps
72c—Gearchem Pumps
72d—Minilab Pumps
129a—Truck, Transveyor
129b—"New Dimension" Booklet
203a—Vertical Turbines
203b—End Suction Centrifugal Pumps
203c—Sump Pumps
203e—Submersible Pumps
221a—Muriatic Acid
221b—Phenol
221c—Phosphorus Trichloride
221d—Chlorinating Agents
240a—Thermocouples
240b—Thermocouple Assemblies
240c—Electrode Glands
240d—Standard Thermocouples
265a—Torque-Arm Speed Reducers
265b—Para-Flex Couplings
265c—Clutches
275a—Process Industries Applications of Aluminum
275b—Cryogenic Applications of Aluminum
275c—Aluminum Heat Exchanger Tubes
277a—Pipe & Fittings
277b—Unitrace—Combines Piping & Tracing in One Unit
277c—Duotrace—Technical Report
277d—Welding Aluminum
279—Heat Exchangers & Condensers

Reprints Now Available

CE editorial reprints are now easy to get—use Reader Service Card for fast service. *For each reprint you want just circle its number on the card. Fill in the blanks on the front, mail. Send remittance if you wish.

For a new reprinting of Chemical Engineering's cost estimating articles; see p. 317

• MATERIALS OF CONSTRUCTION

Corrosion—Refresher on cause & cure ($1).....131
High-Temperature Materials—Inorganic, nonmetals (75¢).120
High-Temperature Metals—Selection, directory ($1)....129
Lead Installations—Best designs for many uses (50¢).. 79
Nonmetallic Inorganic—For severe conditions (50¢)....125
Plastic Pipe—How and when to use (75¢).....135
Process Piping Materials—Selection directory ($1).....169
Protective Linings—Choice, application, directory ($1).. 88

• PROCESSES

Advanced Chemical Rocket Propulsion Systems (50¢)...179
Bio-oxidation—Treatment of wastes (50¢)..... 68
Chemicals From Petroleum—Available processes ($1)..139
Chemical Rocket Propulsion Systems (50¢).....177
Extractive Metallurgy—By chemical processing (50¢)..111
Ultra-Low Temperatures—Production and uses (50¢)...133
Fermentation—Its chemical technology (50¢)..... 74
High-Temperature Technology—Materials, uses (50¢).. 91
Manufactured Gas—To supplement natural gas (50¢)...115
Moving Bed Processes—Theory plus application (75¢).. 64
Nuclear Industry—Role of chemical engineers (50¢).... 89
Nuclear Wastes—Treatment and disposal (50¢).....150
Odor Control—How to be a good neighbor (50¢)..... 98
Operation & Maintenance—The impact of trends ($1)...121
Photochemical Engineering—Uses, equipment (75¢).... 59
Plants & Facilities—Tenth Inventory, 1959 (75¢).....158
Plants & Facilities—Eleventh Inventory, 1960 (50¢).....167
Plants & Facilities—Twelfth Inventory, 1961 (50¢).....178
Processes & Technology—Ninth Inventory, 1959 (50¢)..159
Processes & Technology—Tenth Inventory, 1960 (50¢)..171
Processes & Technology
Eleventh Inventory 1961 (50¢) 184

• CHEMICAL ENGINEERING SCIENCE

Analog & Digital Computers—In engineering use (50¢)..145
Conference on the New Chemical Engineering ($1.50)..173
Pilot Plant—All the aspects of scale up ($1).....127
Speculative Process Design—Pilot Plant bypass (50¢)..146
Statistics—How to use data effectively (75¢)..... 73
Systems Engineering—86-page review ($1.25).....181
CE Refresher
Thermodynamic Principles (50¢)..... 42
Compression & Expansion (50¢)..... 45
Chemical Equilibrium (50¢)..... 49
Homogeneous Kinetics (50¢)..... 57
Catalytic Kinetics (50¢)..... 61
Interpreting Kinetics (50¢)..... 72
Complex Reactor Design (50¢)..... 75
Catalytic Reactor Design (50¢)..... 81
Reactor Design Problems (50¢)..... 87
Physical Equilibrium I (50¢)..... 90
Physical Equilibrium II (50¢)..... 97
Fluid Flow Equations (50¢).....101
Fundamental Mathematics (75¢).....113
Mass Transfer Operations ($1).....130
Unit Operations Refresher
Fluid Flow (50¢).....144
Sedimentation Theory (50¢).....148
Heat Transfer (50¢).....155
Unsteady State Heat Transfer (50¢).....164
Absorption Methods—(50¢) 168
Distillation (75¢).....180

• EQUIPMENT AND DESIGN

Air Pollution—CPI plant solutions (50¢).....143
Control Valves—Behavior and selection (75¢).....141
Electrical Safety—Design methods (50¢).....185
Estimating Engineering Properties
Thermal Cond. (50¢)...94 Viscosity (75¢) 138
Heat Capacities (75¢).109 Critical Properties (75¢).149
Latent Heat (75¢).....117 Other Physical Properties
Surface Tension (75¢).126 (50¢) 151
Flow Sheets—Engineering communiques (50¢).....151
Flow File—50 design formulas (50¢).....112
Flow Through Packing and Beds
Packed Towers (50¢).....103
Fixed and Moving Beds (50¢).....107
Fluidized Systems (50¢).....108
Heat Exchanger Design—Shortcut methods (75¢)..... 52
Heat Exchanger Calculations—Use these charts ($1)...136
Mechanical Seals—How to select and use (50¢)..... 83
Packaging—Unit containers for chemicals (50¢).....166
Piping—Roundup of process pipe, valves, fittings (75¢).. 40
Process Control—Instrumentation report ($1).....183
Process Design: Fluid Flow—Size lines, pick pumps ($1).161
Pump Seals—Chemical plant practice (50¢)..... 92
Water Conservation—Will taps run dry? (50¢).....105
Water Pollution—Solve plant problems (50¢).....122
Your Design Reference File
Parts I-V (75¢).....100
Parts VI-IX (75¢).....110

• COSTS AND COMMERCE

Buyer-Seller Relations—Vendor's view (50¢).....157
Capital Cost Estimating—Data, sources & methods ($1).156
Capital Investments—Appraisal methods (50¢).....182
CE Cost File, 1959—Quick estimating data (50¢).....153
CE Cost File, 1960—Quick estimating data ($1).....172
Cost Control Systems—Reduce and control costs (50¢).102
CPI Forecast for '61—(50¢).....170
Operator Shift Schedules—How to organize (50¢).....175
Patent Fundamentals—Timely review (50¢).....114
Petrochemicals—1958 economic review (50¢).....123
Petrochemicals—1960 economic review (75¢).....176
Process Energy—Make or buy? (50¢). 142
Professional Registration—For PE-minded ChE's (50¢). 85
Rockets and Missiles—Airborne reactor problems (75¢).119
60's Challenge Chemical Engineers (50¢).....152

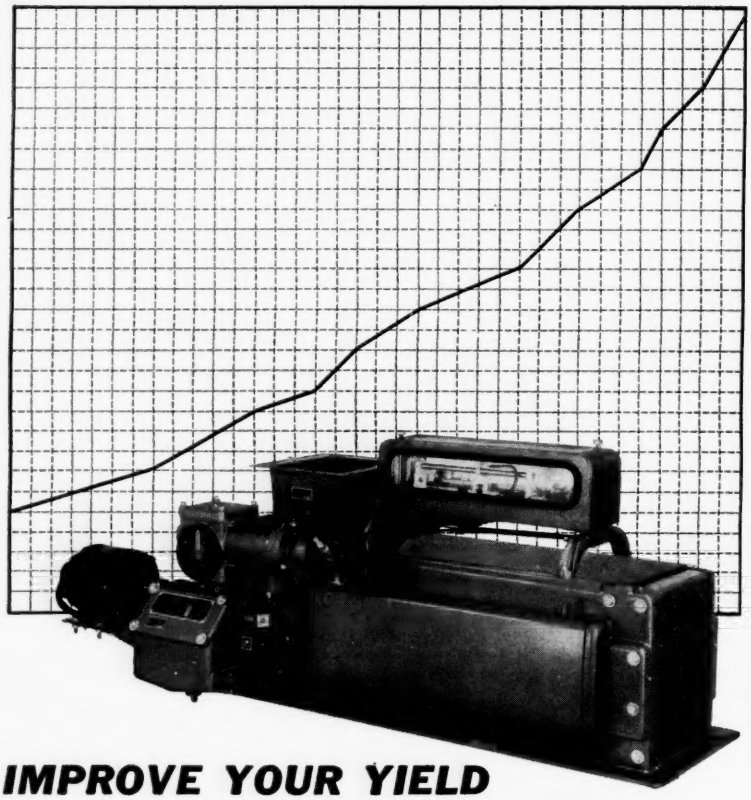
• UNIT OPERATIONS

Absorption With Chemical Reaction—(50¢).....162
Adsorption—Design, methods, materials (50¢).....154
Azeotropic Separation—Close-boiler distillation (50¢)...160
Batch Distillation of Binary Mixtures (50¢).....174
Binary Distillation—Theory, equipment (75¢)..... 54
Compressible Fluids—How to handle ($1)..... 80
Crystallization—For purification (50¢).....124
Drying—Methods, equipment, design, cost (75¢)..... 70
Foams—How to use and control (50¢)..... 86
Liquefied Compressed Gases—Handle with care (50¢)..147
Liquid-Gas Contacting—A practical study (75¢)..... 82
Liquid Proportioning—Equipment, methods, uses (50¢).. 76
Lubrication—For chemical plant engineers (50¢)..... 50
Plant Startups—Systematic preparation (50¢).....165
Solids Concentration—Survey of techniques (50¢)..... 67
Solids-Gas Contacting—Commercial practice (50¢)..... 63
Solids-Liquid Separation—Operations descriptions ($1). 62
Solid-Solid Blending—Theory, practice, equipment (75¢).163

RECENT REPRINTS—TO KEEP YOUR FILES UP-TO-DATE

Disaster Control—Plan in advance (50¢).....186
Non-Newtonian Fluid Flow—Saleup ($1).....188
Petrochemicals—What's ahead (50¢).....189
Plants & Facilities—13th Inventory, 1961 (50¢).....191
Simultaneous Heat & Mass Transfer—Refresher (50¢) 187
Ultrasonics in Processing—Uses and trends (50¢)....190

*Don't forget to check the Free Reprint box for your extra copy of this issue's reprint feature (p. 210)



IMPROVE YOUR YIELD WITH 99% FEEDING ACCURACY...

THE W&T MERCHEN FEEDER

If you need accurate control of dry, free flowing materials to keep process yields high, count on the W&T Merchen Feeder. The Merchen controls dry flow to a hairsbreadth, hour after hour.

Pick any minute any time in your run. Pick one at high capacity, another at low capacity. The Merchen holds accuracy to ±1% from minute to minute . . . stretches the minutes into hours of precise feeding. You solve tough feeding and continuous-blending problems, get sure quality control.

Accuracy comes from sensitivity. And a change of just one ounce in a 63-pound belt load actuates the Merchen's control mechanism. It responds instantly. Accuracy is assured.

This versatile Wallace & Tiernan Feeder has other advantages: It's a straight gravimetric feeder; it feeds and controls other equipment; or it feeds in proportion to any 3-15 psi signal. Corrosion-resistant construction lets it handle most chemicals. And even the largest model occupies less than 3 x 5 feet of floor space.

For more information, write Dept. M-64.29.

WALLACE & TIERNAN INC.
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

Manufacturers' Literature

Contents of This Issue

Chemicals	272
Construction materials	275
Electrical & mechanical	279
Handling & packaging	281
Heating & cooling	282
Instruments & controls	284
Pipe, fittings, valves	285
Process Equipment	290
Pumps, fans, compressors	295
Services & miscellaneous	297

Chemicals

Aluminas.....are produced in numerous grades and types to fit the needs of your product or process. They are readily available in large quantities at reasonable prices.
233 *Aluminum Co. of America

Anhydrous Ammonia.....Booklet supplies information of value in ensuring maximum safety and efficiency in handling of chemical and details its use as a refrigerant.
272A African Ex. & Chem. Ind.

Benzene.....Production has been increased to meet your rising needs. Capacity now exceeds 80 million gallons. Full facts on benzene are available on request.
86 *Shell Oil Company

1,3-Butylene Glycol.....now offered in commercial quantities. For production of polyesters, polyurethanes, surface active agents, etc. Technical data offered.
51-52e *Celanese Chemical Co.

Catalyst Carriers.....Macroport "A" are currently available as spheres, pellets, and aggregate of fused aluminum oxide. Complete details on Macroport "A" carriers.
81 *Norton Company

Chemical, Sulfan.....Technical brochures, "Reactions of Sulfur Trioxide" and "Sulfan" have been prepared outlining the many advantages of Sulfan and are available.
91 *Allied Chemical

Chemicals.....Armoflo compounds are described in a new, revised edition of "Armoflo- Armour Anti-dusting & Anti-caking Chemicals" which is available.
16-17 *Armour Industrial Chemical Co.

Chromium Chemicals.....For a full description of Mutual chromium chemicals, uses, properties & comprehensive technical data, see Bulletin 52 which is offered.
115 *Solvay Process Div., Allied Chem.

* From advertisement, this issue

Ethyl Alcohols.....give you a perfect balance of quality and service. More than 50 authorized specially denatured alcohol formulations are available. Data Sheets.
209 *Commercial Solvents Corp.

Filter Aid.....For any filtration problem, there's a Celite filter aid grade to give you the exact degree of clarity desired. Details are offered.
165 *Johns-Manville

Fluorocarbon Resins.....Teflon resins are rated for continuous service at 500 deg. F. Can be molded & extruded like other resins. Additional information is offered.
121 *E. I. DuPont de Nemours

Foil Adhesives.....Report incorporates complete discussion on physics of foil bonding, required adhesive properties, and analysis of currently-used foil adhesives.
273A The Borden Chemical Co.

Fused Quartz.....Vitreosil has extreme heat resistance. Available in many types & sizes. Also fabricated to your special needs. Complete, illustrated catalog.
R299 *Thermal Amer. Fused Quartz Co.

Germicides.....Bulletin discusses properties and uses of Hyamine 1622 and Hyamine 10-X, quaternary ammonium germicides effective against a wide variety of microorganisms.
273B Rohm & Haas Co.

Graphite Anodes.....Technical data sheets are offered containing important information about graphite anode properties. Data on surface finishing are also included.
71 *Great Lakes Carbon Corp.

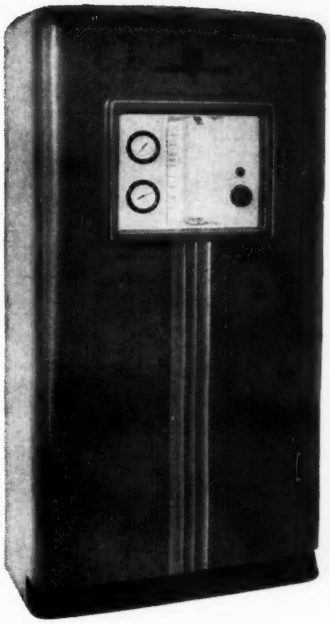
Magnesium Oxide.....Magox is unusually low in cost and high in problem-solving capability. Further information on the unique properties of Magox is offered.
8-9 *Baric, Inc.

Muriatic Acid.....White Grade and Commercial Grade are delivered in rubber lined tank cars. Both are available in three strengths: 18, 20 & 22 degrees Baume. Data.
221a *Hooker Chemical Corp.

Want to build up your files and keep them up-to-date? You can get any publication in this comprehensive guide — free — just for the asking.

It's easy — simply circle item's number on the Reader Service Postcard and mail. Replies will come directly from companies offering the literature.

Solve your industrial water and waste problems -



W&T
V-notch Chlorinators

Wallace & Tiernan V-notch chlorinators provide the economical answer to water- and waste-treatment problems. Chlorine's bacteria- and slime-killing power keeps process and cooling waters slime-free. It destroys cyanide and phenolic wastes. It helps prevent organic fouling of demineralizers.

This Series A-721 V-notch Chlorinator feeds up to 8000 lb./day, over a 20:1 range. It will treat nearly 100 million gallons of water with 10 ppm dosage . . . destroy 1200 lb. of cyanide waste . . . oxidize 800 lb. of ammonia nitrogen. Other V-notch models feed smaller amounts of chlorine, to 10 lb./day. All models can be used for manual, intermittent start-stop, or fully automatic operation. And the V-notch Variable-Orifice gives you pinpoint control.

- *If you have a water or waste treatment problem, W&T has the equipment and know-how to solve it. Write Dept. S-148.29.*

WALLACE & TIERNAN INC.
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

What's News in Mixing?

by COWLES DISSOLVERS

WORLD-WIDE, INDUSTRY-WIDE USERS SAY: "COWLES DISSOLVER® EQUIPMENT MAKES A BIG DIFFERENCE"

If your processing requires dispersion, deagglomeration, mixing or dissolving, the comments of Cowles users all over the free world may point the way to substantial advantages for you. Here are a few hundreds in our files from some 72 countries.—

ENGLAND

". . . . extraordinary good results with these pigments . . . . using our micronized Red Oxide obtained a reading of 8¾ on the P.C. (1-10) Scale in 10 minutes . . . . with our Leadchrome/Prussian Bluegreen obtained 8¼ in 5 minutes."

GERMANY

"With the Cowles we obtain the best wetting out within shortest time. This makes it possible for us to save on mill passes. Because of this the machine has prven o be absolutely invaluable to us."

ITALY

". . . . by using the Cowles as premixer we are saving 2 passes out of 3 on the 3-roller mill."

DENMARK

". . . . Certain products which need roller milling when using traditional mixing methods, can now be produced directly on the Cowles, without roller milling."

COLOMBIA

"Your equipment has provided us with such excellent results that we want immediately to obtain addiional Cowles . . . ."

SPAIN

"The Cowles Dissolver which we bought has given us magnificent results."

JAPAN

"Your equipment works very satisfactorily . . . . It will give high production with the added advantage of easy cleaning and quick change-over."

The high-speed, high-shear principle of the "COWLES DISSOLVER" design, plus the unique transmission system that is capable of delivering over 90% of motor power to the patented impeller, can help you save money, time and space.

Let us prove it in your plant—at our risk!
Write today for more complete information.

MOREHOUSE COWLES

Representatives in Principal Cities.

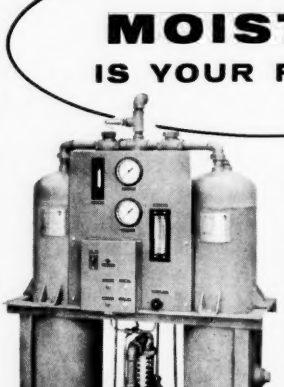
Convenient Lease and Time-Payment Plans.

MOREHOUSE-COWLES, INC
1150 San Fernando Road Los Angeles 65, Calif.

Please send me information on use of "COWLES DISSOLVER" mixtures in processing (product).....
.....
Name .....Title.....
Firm .....
Address .....
City .....Zone.....State.....

#426

IF
MOISTURE
IS YOUR PROBLEM



. . . moisture in compressed air, organic liquids or gases; moisture that slows down production, causes rust, corrosion or inefficient processing . . . then you need a Kahn Dryer.

There are Kahn Dryers—and fully integrated adsorption systems—for every industrial, laboratory and military need. Pressures to 10,000 psi . . . flow rates to 5,000 scfm . . . heater, heaterless, disposable cartridge, and regenerative types. For drying to dew points of —120° F or lower . . . and selective adsorption for higher purity.

Write for our new booklet, "Moisture Is Your Problem", containing the latest facts on moisture control.

kc

Kahn and Company, Inc.
DRYER DIVISION
885B Wells Road, Wethersfield, Connecticut
DRYERS—SPECIALIZED CONTROL INSTRUMENTS—TEST STANDS

Liquid fertilizer solutions accurately, quickly metered with Rotron Whirl-Flo Flowmeters by Allied Chemical Corporation

Fertilizer must be marketed quickly and accurately from manufacturer through distributor to user in order to meet today's agricultural needs. Allied Chemical Corporation, Nitrogen Division, now has over thirty Rotron meters serving efficiently at its plants and distribution points throughout the country, from which they market ammonium nitrate, ammonia and urea liquid fertilizer formulations.

According to Allied spokesmen, the Rotron meter with integral totalizer permits faster transport loading to the desired gallonage. By eliminating the "topping off" procedure previously used in loading by weight, they have saved time now used to fill and roll five or six extra payloads on the road every day. This is real money in the pocket when distributor stocks need refilling.

Our experienced engineers will be glad to show you how Rotron Whirl-Flo Flowmeters can pay off for you, too. Write today for complete information.

ROTRON®

ROTRON CONTROLS
Division of Rotron Mfg. Co., Inc.
67 Bearsville Road, Woodstock, N. Y.

LITERATURE . . .

Nitrogen Manufacturing.....4-page illustrated bulletin describes automatic packaged nitrogen manufacturing system and includes schematic flow diagram illustrating operation.
275A Louis DeMarkus Corp.

Oxygen.....Tonnage oxygen plants built and operated for your oxygen-nitrogen processes. No capital investment; you pay only for oxygen. Details available.
22-23 *Air Reduction Co.

Paraformaldehyde.....is the low-price, free-flowing white solid. One of the most uninhibited chemicals around. More specific information is available.
51-52c *Celanese Chemical Co.

Phenol.....Its distillation range is only 2 deg. from first drop to dryness. Data sheets are offered giving all specifications on this product.
221b *Hooker Chemical Corp.

Phosphorus Trichloride....A clear and water-white liquid. 99.9% pure. No free phosphorus. Additional information contained in Phosphorus Trichloride Data Sheet.
221c *Hooker Chemical Corp.

Plastic.....Teflon is easily bondable to other materials and to itself with commercial adhesives. Complete Teflon service to help improve design & increase reliability.
250 *Raybestos-Manhattan, Inc.

Plasticizers.....Plasticizing of resin coatings is covered from acrylics to zein in 54-page bulletin that contains 10 tables of comparative evaluations of plasticizers.
275B Monsanto Chemical Co.

Silicones.....New descriptive brochure, "Why Silicone-Based Paints Mean Less Maintenance" is available. Covers the new paints based on silicone resins.
209 *Dow Corning Corp.

Sodium Borohydride.....assures purity in the manufacture of glycols. A new technical bulletin, just published gives details and is available on request. Bul. 509.
103 *Metal Hydrides, Inc.

Solvent.....New improved Varsol offers long-lasting freshness. Retains its efficient solvency even after long storage or many processings in your plant. Information.
219 *Humble Oil & Refining Co.

Tetrahydrophthalic Anhydride.....21-page technical bulletin gives physical and chemical properties, toxicity, handling precautions and uses of chemical.
275C National Aniline Div.

Construction Materials

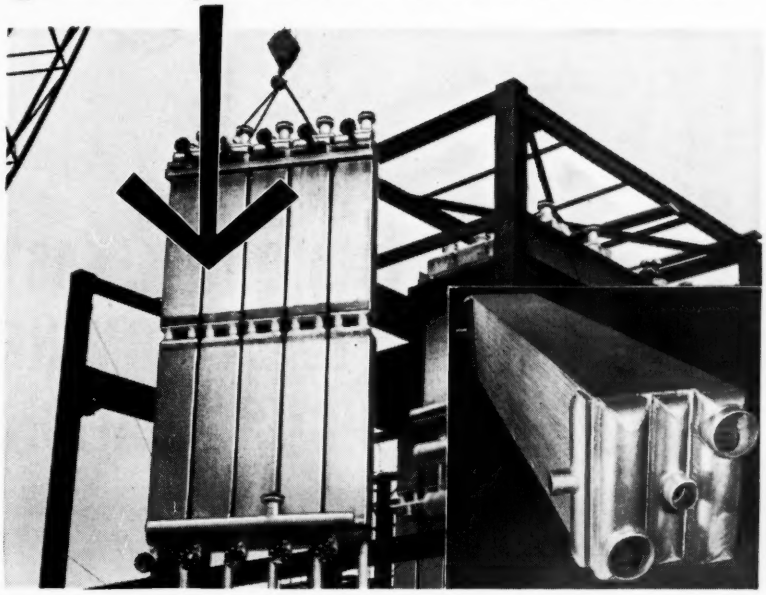
Alloys.....Information about the properties and corrosion resistance of Alloy C and other Hastelloy alloys contained in a booklet which is available on request.
223 *Haynes Stellite Company

Alloys.....A new folder is available listing all of the alloys available and gives data on the chemical composition of the complete line of alloys.
267b *International Nickel Co.

*From advertisement, this issue

from ALCOA

good designs made better with aluminum



Rohm & Haas reports close-temperature approaches, efficient oxygen production with Trane Brazed Aluminum Heat Exchangers

Trane Brazed Aluminum Heat Exchangers, made with Alcoa® Aluminum, are used in the production of tonnage oxygen at the Rohm & Haas plant, Pasadena, Texas. (Inset shows assembly unit.) After three years of operation, Rohm & Haas reports temperature approaches as close as 2°F, operating temperatures as low as –291°F. Close temperature approaches give very high thermal efficiency, high recovery of refrigeration and consequent economical operation. Ideal for cryogenic equipment, Alcoa Aluminum alloys maintain ductility and resistance to shock loading at extremely low temperatures. In fact, tensile and yield strengths actually improve in the cryogenic ranges without embrittlement. Please send the coupon for more information.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

Aluminum Company of America, 825-K Alcoa Building, Pittsburgh 19, Pa.
Please send me the following literature:
☐ 68-10460 *Process Industries Applications of Alcoa Aluminum*
☐ 88-11251 *Cryogenic Applications of Alcoa Aluminum*
☐ 34-11566 *Alcoa Aluminum Heat Exchanger Tubes*

Name_____ Title_____
Company_____
Address_____
City_____ Zone_____ State_____

HERE IS A QUICK, EASY WAY TO DETERMINE TRUE ECONOMIC INSULATION THICKNESS

A simple evaluation system from Owens-Corning called **DIVIDEND ENGINEERING**

Now you can determine the "thermo-economic" performance of any Fiberglas* insulation in any power or process application—quickly, easily—and *accurately*.

Data never available before the electronic computer age have been compiled into a simple, easy reference system that can save countless hours of time. This system is called Dividend Engineering. It takes into account *all* the fixed and variable factors that affect the true economic thickness of the insulation: areas to be insulated, cost of heat, capital investment in insulation, maintenance, installation, capital recovery and depreciation. It also includes "hidden" costs never before readily computable. The dollars-and-cents difference between Dividend Engineering figures and those arrived at through previous evaluation methods often is astonishing.

SEND FOR THIS FREE BOOKLET on Dividend Engineering. It shows how, with the help of this system, you can not only design new plants to produce maximum return on investment; you can also upgrade existing installations to operate more efficiently. Write today to: Owens-Corning Fiberglas Corporation, Industrial & Commercial Division, 717 Fifth Avenue, New York 22, New York.

OWENS-CORNING RESEARCH pioneers new ideas in

OWENS-CORNING FIBERGLAS

*T.M. (Reg. U.S. Pat. Off.) O-C.F. Corp.

LITERATURE . . .

Aluminum.....A booklet entitled, "Process Industries Applications of Alcoa Aluminum" is available for information on the wide variety of applications of aluminum.
275a *Aluminum Co. of America

Aluminum Conduit.....solves most corrosion problems in and around chemical plants. It's light weight, nonmagnetic and non-sparking. Additional information available.
145 *Rome Cable Div., Alcoa

Aluminum Plate.....A new development to cut tank construction costs —tapered aluminum plate. Details and specifications on this new development are offered.
239 *Reynolds Metals Co.

Casting Alloy....."HOM" is a special high nickel alloy developed to produce castings that meet high temperature requirements. Additional information.
311 *The Duraloy Co.

Coating.....No matter what the size or shapes of your product, it can be coated better with Kanigen nickel alloy. Detailed information in Bulletin 561.
156 *General American Transportation

Coating Systems.....Corrosion Data File includes a survey of corrosion problems in the Chemical Industry, data on Systems & a coating selector guide.
46-47 *Pittsburgh Chemical Co.

Coatings & Enamels.....Imlar vinylmastic coatings & vinyl enamels have been developed for use where metal protective finishes are not recommended. Bulletin.
74a *E. I. DuPont de Nemours

Epoxy Enamels....Corlar epoxy chemical-resistant enamels have been developed for surfaces subject to severe corrosive conditions. Technical bulletin is offered.
74b *E. I. Du Pont de Nemours

Filter Fabrics.....The handy informative booklet, "Filter Fabric Facts" contains distributors names and answers problems related to your selection of filter fabrics.
244 *Wellington Sears Co.

Glass Fabrics.....Many weaves of glass fabrics engineered for liquid filtration, plastics lamination, high temp. dust collection or insulation. Samples are offered.
L278 *National Filter Media Corp.

Insulating Cement....#1 Plus insulating cement is effective up to 2100F. Provides a comfortable margin of protection for excellent thermal efficiency. Data.
97 *Baldwin-Ehret-Hill, Inc.

Insulation....Careytemp is a new pipe and block insulation material featuring high moisture resistance, low shrinkage and high acid and corrosion resistance.
10-11 *Philip Carey Mfg. Co.

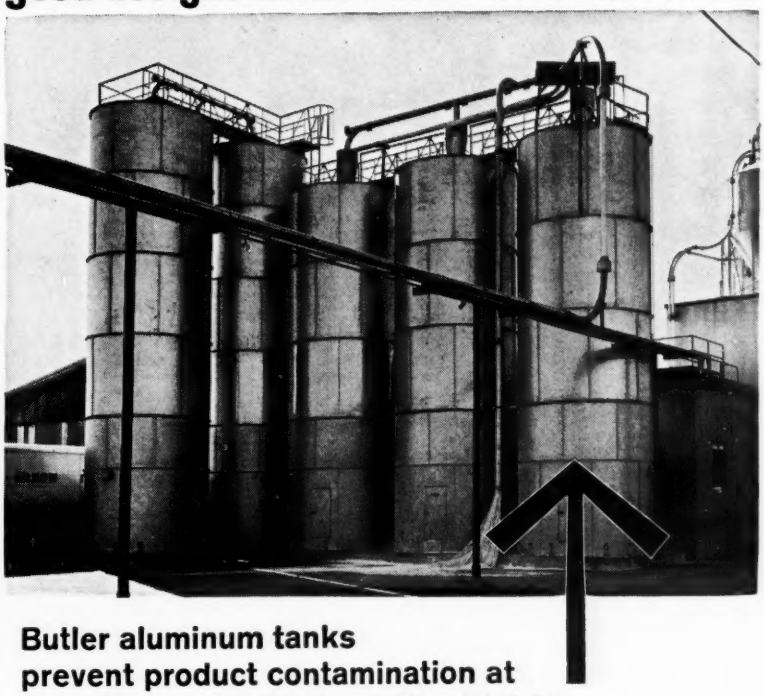
Insulation.....Integrated pipe insulation of metal jacketing, high temperature calcium silicate insulation and moisture barrier in one fabricated unit described in bulletin.
277A Johns-Manville

Lead Products.....These products include chemical lead sheets to your requirements; pipe, bends, traps & standard fittings. Bul. 162, the Lead Handbook for the CPI.
128 *American Smelting & Refining

* From advertisement, this issue

from ALCOA

good designs made better with aluminum



Butler aluminum tanks prevent product contamination at Dow Chemical's Saginaw Bay Division

This aluminum storage installation maintains product purity for the polychemicals department of Dow Chemical Co., Bay City, Mich. Used for polystyrene, polypropylene or polyvinyl chloride, these bolted tanks were fabricated of ALCOA® Aluminum by the Bulk Storage Division of Butler Manufacturing Co., Kansas City, Mo. Many sensitive chemicals and oils are handled today in aluminum to avoid product degradation or decomposition. Moreover, low initial cost and no maintenance make aluminum an economical investment. We'd like to send you more information. Please mail the coupon.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

Aluminum Company of America, 825-KK Alcoa Building, Pittsburgh 19, Pa.
Please send me the following literature covering Alcoa Aluminum for tubular products and other uses in the process industries:

- ☐ 34-10197 Aluminum Pipe and Fittings
- ☐ 34-10418 Alcoa Unitrace: Combines Piping and Tracing in One Unit
- ☐ DD-514 Alcoa Duotrace Technical Report
- ☐ 68-10460 Process Industries Applications of Alcoa Aluminum
- ☐ 50-19415 Welding Alcoa Aluminum

Name_____ Title_____
Company_____
Address_____
City_____ Zone_____ State_____

GLASS FABRICS

engineered for . . .

• LIQUID FILTRATION • PLASTICS LAMINATION

• HIGH TEMPERATURE DUST COLLECTION • INSULATION

Tell us your application, we will send you samples

Weavers of Industrial Filter Media for over Fifty Years

NFM The NATIONAL FILTER MEDIA Corporation

General Offices and Mills: New Haven 14, Conn.; Western Office and Factory: Salt Lake City 10, Utah, Sales Offices—Representatives: Atlanta, Ga., 990 Lindridge, N.E.; Cleveland 39, Ohio, P.O. Box 9407; Monterey Park (L. A. Area), California, 664 Monterey Pass Road; Chicago, Ill., 6034 N. Cicero Avenue; Houston, Texas, 1607 Jefferson Avenue; Toronto, Ontario, C.P.R. Roadway, 1119 Yonge Street.

THESE ADVANTAGES MAKE

DARNELL

CASTERS & WHEELS

YOUR BEST BUY

RUBBER TREADS . . . a wide choice of treads suited to all types of floors, including Darnelloprene oil, water and chemical-resistant treads, make Darnell Casters and Wheels highly adapted to rough usage.

RUST-PROOFED . . . by zinc plating, Darnell Casters give longer, care-free life wherever water, steam and corroding chemicals are freely used.

LUBRICATION . . . all swivel and wheel bearings are factory packed with a high quality grease that "stands up" under attack by heat and water. Zerk fittings are provided for quick grease-gun lubrication.

STRING GUARDS . . . Even though string and ravelings may wind around the hub, these string guards insure easy rolling at all times.

Look in the YELLOW PAGES

Send for Your FREE Copy...

DARNELL CORPORATION, LTD.

DOWNEY (Los Angeles County) CALIF.
37-28 SIXTY-FIRST, WOODSIDE 77, L.I., N.Y.
36 NORTH CLINTON ST., CHICAGO 6, ILL.
1000 PEACHTREE N. E., ATLANTA, GA.

LITERATURE . . .

Material of Construction.....Booklet B-111B "Properties of Kennametal" and the new booklet B-666, "Proven Uses of Kennametal and Kentanium" are available on request.
L292 *Kennametal Inc.

Mechanical Packing.....for all requirements. Lengthen the life of shafts, reduce friction and heat and minimize wear & maintenance. Literature is offered.
232 *Hercules Packing Corp.

Mechanical Packings.....A full line of mechanical packings such as high pressure asbestos, rotary pump packings, valve packings and many others.
249 *Belmont Packing & Rubber Co.

Metal Protective Finishes.....Dulux metal protective finishes can take care of 85% of your maintenance painting requirements. Details in technical bulletin.
74c *E. I. Du Pont de Nemours

Metallic Medium.....Neva-Clog serves best as a resin retainer, regenerant distributor, granular carbon support, precoat filter medium. Details in Bulletin 613.
L300 *Multi-Metal Wire Cloth Co.

Mortars.....Polysulfide-base mortars provide a smooth or skidproof surface, as desired and are ready for traffic in less than one day. Brochure FC-100 is available.
58 *Thiokol Chemical Corp.

Pipe Protection Tape.....Scotchrap pipe protection tape to protect any metal surface from rust caused by fumes, oil, water, caustics greases & most solvents.
TL283 *Minn. Mining & Mfg. Co.

Refractories.....to answer your specific needs. Varied unusual refractories to solve unusual problems. Further information is contained in descriptive brochures.
54-55 *Carborundum Co.

Silicone Heat Resistant Finish..... Brochure shows how Sicon achieves more product appeal . . . withstands 550 F. temperatures without loss of color or gloss.
R294 *Midland Industrial Finishes Co.

Tank Linings.....Triflex lining is a combination of hard rubber sandwiched between soft rubber that stands the most corrosive acids. Information is available.
1 *B. F. Goodrich

Tile.....Acid-proof Duro tile for the most durable chemical resistant floors. It is dense and non-absorbant throughout the entire thickness.
125-126 *Harbison-Walker Refractories

Welding Aluminum.....Literature is available giving detailed information welding aluminum in your various applications and may be had upon request.
277d *Aluminum Co. of America

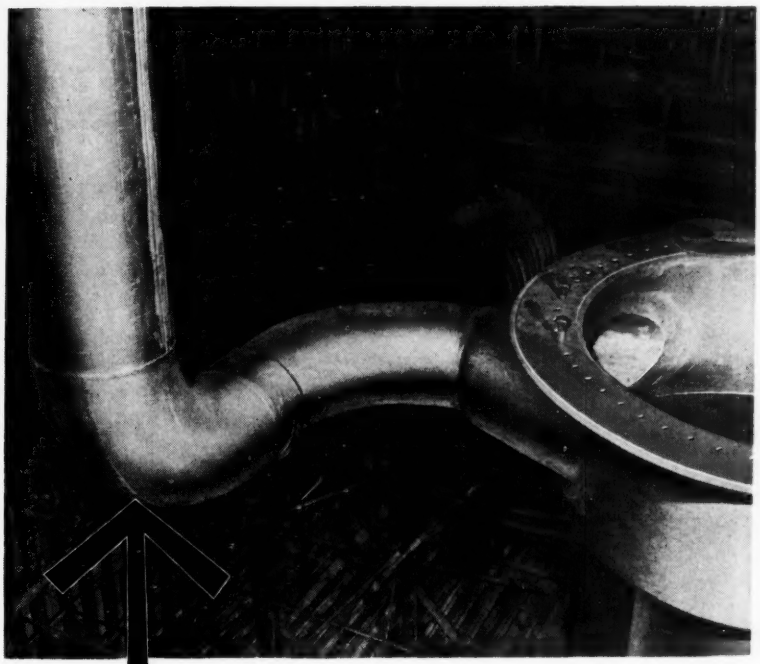
Electrical & Mechanical

Couplings.....for every operation that calls for quick, tight connections. Available in brass, malleable, stainless, aluminum, etc. Details in illustrated Catalog C-11.
99 *Ever-Tite Coupling Co., Inc.

* From advertisement, this issue

from ALCOA

good designs made better with aluminum



Aluminum cooling system at Oak Ridge includes Tube-Turn fittings

At Oak Ridge National Laboratory, a cooling system utilizing aluminum forces more than 12,000 gal of water per minute through the research reactor. Welding fittings up to 24 in., thought to be the world's largest of aluminum, were made with Alcoa® Aluminum by Tube Turns Division of Chemetron Corporation, Louisville, Ky. Aluminum was selected to maintain purity of the demineralized water. Other advantages: aluminum's low cost, corrosion resistance and superior heat-transfer ability. To take advantage of Alcoa's 35 years of heat exchanger experience, please send the coupon.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

Aluminum Company of America, 825-X Alcoa Building, Pittsburgh 19, Pa.

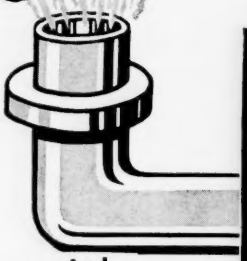
Please send me the following literature:

☐ 34-10197 *Aluminum Pipe and Fittings*
☐ 68-10460 *Process Industries Applications of Alcoa Aluminum*
☐ 34-11566 *Alcoa Aluminum Heat Exchangers and Condensers*

Name_____Title_____
Company_____
Address_____
City_____Zone_____State_____

STOP NOISE

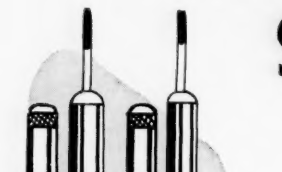
WOMP WOMP WOMP

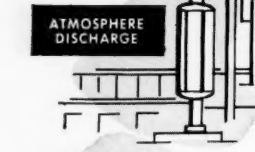


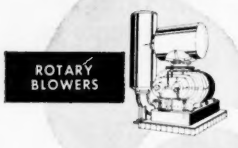
From AIR, STEAM and other GAS DISCHARGES

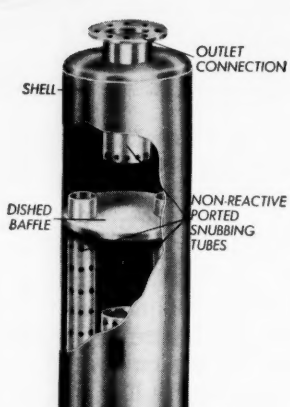
with

BURGESS-MANNING SNUBBERS









Troublesome noise is permanently silenced by a patented principle of "snubbing" the exhaust surges. In no way is the operating efficiency of the equipment impaired. There are no moving parts... no maintenance... no repairs. Fabricated of heavy-gauge, high-grade steel for a long life of dependable service. If noisy exhausts are your problem contact us now. We have never failed to solve a noise problem.

Industrial Silencer Division

BURGESS-MANNING COMPANY

The Sound-Engineering People

9246 SOVEREIGN ROW • DALLAS 7, TEXAS
NEW YORK • CHICAGO • LOS ANGELES
REPRESENTATIVES WORLD WIDE

LITERATURE . . .

Drives.....In addition to defining adjustable speed drives and their role in industry, brochure 6999 deals with product description and application, and factors in selection.
280A General Electric Co.

Drives & Couplings.....8 stock drives and 11 stock couplings for fractional to 1,000 hp. requirements listed in 20-page bulletin that includes a simplified selection method.
280B Dodge Mfg. Corp.

Dry Fluid Drives....Flexidyne is available, off the shelf, in Drives & Couplings. Capacities range from fractional to 1,000 hp. Technical bulletin.
264 *Dodge Mfg. Corp.

Electrode Glands.....provide pressure seals for electrical leads into systems operating from .005 microns absolute to 2500 psi. Details in Catalog 960 which is available.
240c *Conax Corp.

Expansion Joints.....Catalog AD-137 contains information on solid teflon and teflon-lined expansion joints for chemical processing applications.
134 *Garlock Inc.

Gas Turbines.....Full details on how 305 gas turbines can bring you lower first cost, reduced floor space & installation costs in Bulletin 186.
143 *Clark Bros. Co.

Motors.....Key manufacturing operations employed in maintaining the required close tolerances are described in "The Fine Art of Building Better Motors".
38-39 *Elliott Company

Motors.....Syncrogear motors offer the most features to provide long life and dependability. A color illustrated brochure, No. F-1880 is available on request.
319 *U. S. Electrical Motors, Inc.

Oil-Break Starters....Type ZHS starters are specifically designed for dusty, corrosive atmospheres. Details on this line are contained in Bulletin 8130.
73 *Square D Company

Packing Rings.....are precision made to always give you a perfect seal—no matter how difficult the special sealing requirements of your application. Information.
67 *C. Lee Cook

Rotor Motors.... Ranging in size from 1-30 hp., motor designed to meet requirements of any wound rotor application including elevators, hoists, etc., is described in bulletin.
280C Louis Allis Co.

Speed Reducers.....Right angle horizontal type YB speed reducers are detailed in Bulletin 2100 while type Y parallel shaft speed reducers are in Bulletin 1100.
12-13 *The Falk Corp.

Speed Reducers.....Spiral bevel-helical reducers for high efficiency on heavy drive applications. Details are contained in Catalog 42C which is available.
228 *D. O. James Gear Mfg. Co.

Thermocouples.....Cono-Clad mineral insulated thermocouples eliminate corrosion & contamination potential. Facts are contained in Bulletin 300 which is offered.
240a *Conax Corp.

* From advertisement, this issue

ERATURE . . .

ermocouples.....Ceramo thermocouples can bend to almost any configuration. More than 48 pages of profitable information on every type fill Catalog TC-4.
248 *Thermo Electric Co., Inc.

bines.....built to customers' specifications, including API and NEMA standards. A complete range from 1 hp to 250 hp. Further information in Catalog 200.
151 *Coppus Engineering Corp.

Handling & Packaging

gs.....Bemi-Strip bags won't open until you grab the tab. Products can be shipped, stored and handled with complete confidence that they won't open accidently.
163 *Bemis Bro. Bag Co.

veyor Systems.....for tailor-made solutions to your bulk materials handling problems. New efficiency and greater profit is possible with these custom-made systems.
40-41 *Barber-Greene

ms.....for handling chlorides & other corrosive chemicals fabricated from Nickel 200. An informative booklet, "Engineering Properties of Nickel" is offered.
267a *International Nickel Co.

Transports.....Extreme mobility & economical storage make Taylor-Wharton gas transports ideal for bulk transportation of compressed gases. Information.
66 Harrisburg Steel Co.

der.....Loads can palletized or stacked in any pattern, also put into warehouse storage. Literature & engineering details are available.
BL317 *Power-Curve Conveyor Co.

erials Handling.....Portable Airveyor transfer units convey pelletized or granulated materials with high efficiency. Full details in Bulletin A-23.
315 *Fuller Company

es, Industrial.....When you have a problem in weighing, testing, ccunting, batching, sorting or weight data processing. Information is available.
294a *Toledo Scale Corp.

tor-Shovel.....Model H-25 Payloader has dual-filtering of engine intake. "Industrial Materials Handling from A to Z" is available for details.
157 *The Frank G. Hough Co.

k.....Model VST Transveyor sets a new standard for driving ease, serviceability and lower operating cost. Complete specifications & feature data are offered.
129a *Automatic Transp. Co.

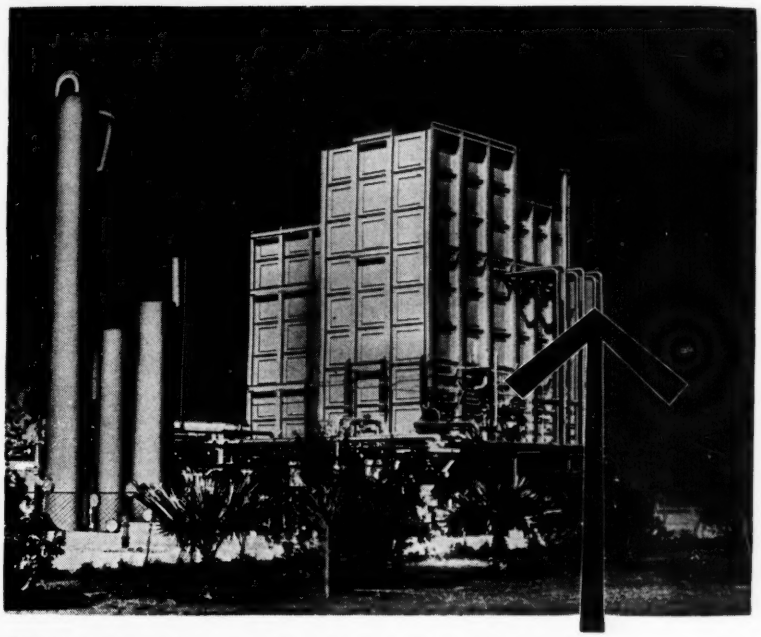
rating Conveyors....Conveyors with variable stroke positive drive that provide infinitely variable conveying speeds from zero to maximum are described in brochure 361.
281A Stephens-Adamson Mfg. Co.

ehouse Scales.....Complete information on both self-contained and built-in scales to cut costs and save time when weighing materials on power or hand trucks.
207 *Fairbanks, Morse & Co.

From advertisement, this issue

from ALCOA

good designs made better with aluminum



Alcoa Aluminum stands up at cryogenic temperatures in oxygen plant designed and manufactured by Air Products, Inc.

At this oxygen plant built by Air Products, Inc., Allentown, Pa., for production of organic chemicals, aluminum was the logical material for construction of cryogenic equipment. ALCOA® Aluminum alloys have the ability to maintain ductility and resistance to shock loading at extremely low temperatures. In fact, tensile and yield strengths actually improve in the cryogenic ranges without embrittlement. Add low cost and ease of fabrication—small wonder that aluminum is preferred for low-temperature process vessels and transportation equipment. The coupon will bring you more information.

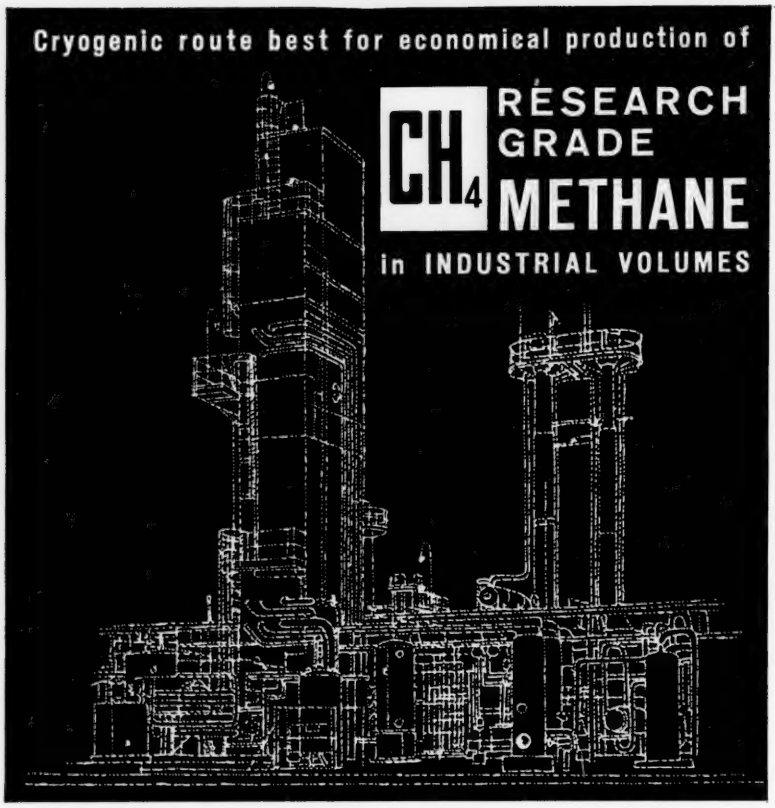
ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

Aluminum Company of America, 825-XX Alcoa Building, Pittsburgh 19, Pa.

Please send me the following literature covering Alcoa Aluminum for tubular products and other uses in the process industries.

☐ 68-10460 Process Industries Applications of Alcoa Aluminum
☐ 88-11251 Cryogenic Applications of Alcoa Aluminum

Name_____ Title_____
Company_____
Address_____
City_____ Zone_____ State_____



Low-temperature techniques have proved to be the modern route to greater economies and general all-round process efficiency in the recovery and purification of numerous gases. Methane is a typical example.

Impurities in the feed gas are first localized and removed at a single point in the process. This is followed by low-temperature separation of the Methane, resulting in a product of the highest possible purity.

Air Liquide Methane plants, as with all our low-temperature plants, are built to exacting standards and the application of *Cryotechniques* developed over more than half a century of experience.

Design practices are conservative and we use the highest quality materials and construction methods—the hallmark of Air Liquide plants everywhere.

Custom design is our specialty. Write or call if you plan increases or modifications in your plant, whether for Methane or other gaseous products —Air Liquide Cryotechniques may provide the answer to your problems.

For further information on Methane production, write for Bulletin CH4-1M-61-3.

Thousands of Air Liquide plants of every type are in use throughout world industry. Here are some of them:

- Air Separation—oxygen, nitrogen, and rare gases
- Coke-Oven Gas Separation
- Refinery Gas Separation
- Methane Purification
- Natural Gas Liquefaction
- Pure CO Production
- Heavy Water—for Atomic Reactors
- Hydrogen Liquefaction
- Helium Recovery

AMERICAN AIR LIQUIDE
ENGINEERING & CONSTRUCTION DIVISION
OLDEST IN EXPERIENCE NEWEST IN DESIGN

713 Chrysler Building, 405 Lexington Avenue, New York 17, N.Y. Tel: YUKON 6-6544.

In Canada
L'Air Liquide, 1210 Sherbrooke St. W., Montreal
Tel: VI. 2-5431.

LITERATURE . . .

Heating & Cooling

Air Preheaters.....Ljungstrom package air preheaters for use on boilers from 25,000 to 250,000 pounds of steam per hour. Details in 14-page booklet.
242 *The Air Preheater Corp.

Calciners & Coolers.....Combination rotary calciners and coolers have no equal in treating ores, metal oxides, various chemicals, etc. Bulletin 118-R is offered.
251 *Bartlett-Snow-Pacific, Inc.

Electric Heaters....Chromalox Flange-Type Electric Immersion Heaters are ideal for high-temperature, high-pressure applications. Details in catalog 60.
L260 *Edwin L. Wiegand Company

Gradiation Heating...for batch processing a long list of heat-sensitive materials. Complete details on this system may be had upon request.
R255 *Selas Corp. of America

Grate-Kiln System.....produces consistent high quality using less fuel. Outproduce conventional rotary kilns of the same length by 50%. Further information is available.
48-49b *Allis-Chalmers

Heat Exchanger.....Selection of the right titanium heat exchanger is a sure-fire way of controlling your costs. Performance data & fabrication are offered.
68 *Titanium Metals Corp. of America

Heat Exchangers.....Liquid-Gas heat exchanger units can be supplied in any alloy, any size, for any application. Additional information is offered.
257 *Marlo Coil Co.

Heat Exchangers.....to solve many problems of cooling under intense pressures for many types of chemical, petroleum and petrochemical applications. Bulletins offered.
246 *The Vilter Mfg. Co.

Heat Exchangers.....Transaire air-cooled heat exchangers have found wide acceptance in areas where water cooling is impractical or impossible.
63 *Yuba Consolidated Industries

Heat Exchangers & Condensers.....Literature has been prepared to show the advantages of using aluminum for heat exchangers & condensers and is available on request.
279 *Aluminum Co. of America

Heating Products.....Catalog 956 covers Grid unit heaters, blast heaters and radiators. Designed for operation on steam pressure up to 250 PSI 450 degree temperature.
TC317 *D. J. Murray Mfg. Co.

Mechanical Traps.....for gas, gasoline, air, steam or interface service. Catalog 500, "Mechanical Traps For Steam, Air, Gas" is available on request.
293 *W. H. Nicholson & Co.

Organic Liquid Heaters.....can be modified to meet a wide range of job requirements. They can be arranged for firing with most commercial fuels. Information.
83 *Union Iron Works

* From advertisement, this issue

WRAP-ON RUST PROTECTION

for any metal surface Protect any metal surface from rust caused by fumes, oil, water, caustics, greases and most solvents. This tough polyvinylchloride pressure-sensitive tape provides positive protection on any clean, dry surface and conforms to odd or irregular shapes. Easy to apply, "SCOTCHRAP" Brand Pipe Protection Tape requires no special application technique or equipment and is always ready for use. "SCOTCHRAP" is available from your 3M supplier, or write: Electrical Products Division, 3M Company, 900 Bush Ave., St. Paul 6, Minn.

"SCOTCHRAP" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 6, MINN.

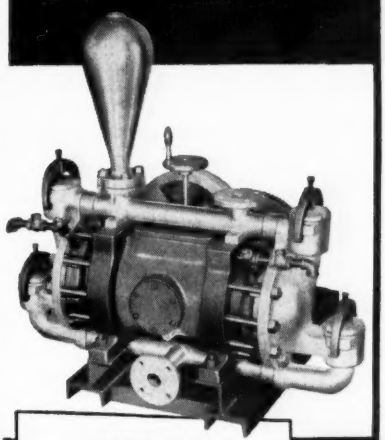
3M MINNESOTA MINING & MANUFACTURING CO.

An excellent sequesterant ... to inactivate troublesome metallic ions...to chemically dissolve deposits and also stabilize them in the solution.

for those

hard-to-handle fluids

- CORROSIVE
- ABRASIVE
- VISCOUS
- THICK
- HEAVY
- QUICK SETTLING
- VALUABLE
- SENSITIVE
- HAZARDOUS

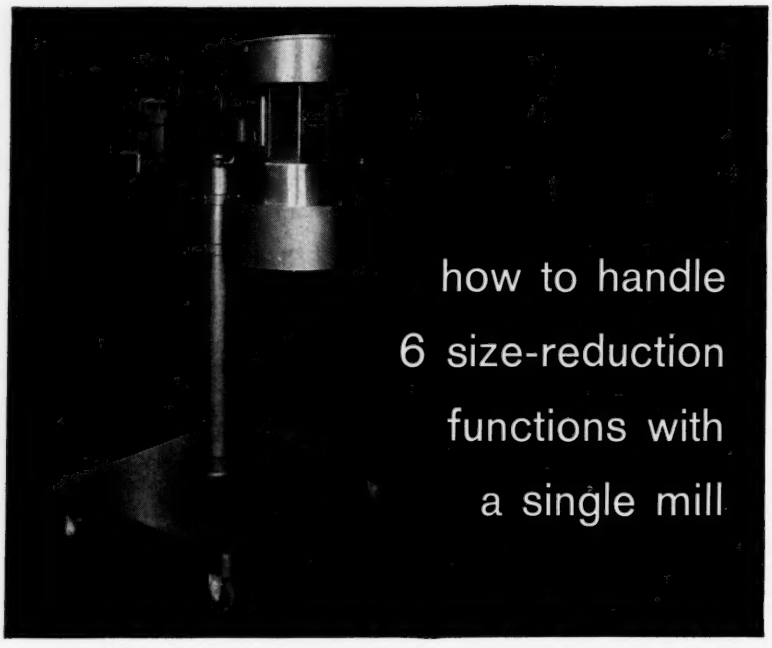


SHRIVER DIAPHRAGM PUMP

- LOW OPERATING COST
- LOW MAINTENANCE COST
- LONGER SERVICE LIFE
- EASY TO CLEAN

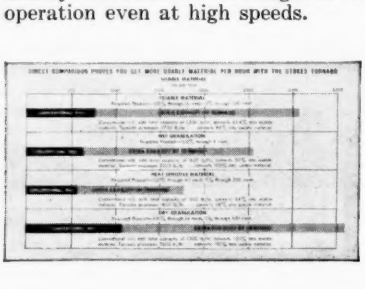
Thousands of Shriver pumps handling materials that clog or wear out other pumps all too quickly have proved their amazing service economy record. It will pay you to get Bulletin 148.

T. SHRIVER & CO., Inc.
802 Hamilton St., Harrison, N. J.



Granulating, pulverizing, dispersing, dissolving, pulping and chopping . . . all 6 functions can be performed on the Stokes Tornado Mill at higher efficiencies and greater product yields than conventional mills. A look at the advanced design features of the Stokes Tornado Mill will tell you why:

- **360° Screen.** This feature provides full working area with no "dead" spots. Products are expelled at the precise moment they reach the desired size. There's no overworking . . . fines are reduced to a minimum . . . for maximum product uniformity.
- **Versatility.** A wide variety of processing chemicals and other materials can be handled efficiently . . . including wet, sticky and heat sensitive materials that other mills can't process without clogging or damaging the product.
- **Easier-To-Clean.** Entire working section can be cleaned and replaced in a matter of minutes, making it easy to switch from one product to another.
- **Portability.** Mounted on casters, the Tornado Mill goes where the work is . . . gives greater utility and convenience.
- **Minimum Maintenance.** There are only two spare parts required. Sturdy construction throughout ensures smooth, vibration-free operation even at high speeds.



WRITE FOR LITERATURE *containing handy chart which shows by* direct comparison *that Stokes Tornado Mills produce more usable material per hour than conventional mills. The extra capacity you get with the Tornado can bring big savings to your milling operation. Write for your copy today.*

Size Reduction Equipment Division

STOKES

F. J. STOKES CORPORATION, 5500 Tabor Road, Philadelphia 20, Pa.

STOKES INTERNATIONAL: PHILADELPHIA • TORONTO • LONDON

LITERATURE . . .

Packaged Boilers.....Sizes through 600 hp . . . oil, gas and combination oil-gas firing . . . larger sizes in Springfield water-tube boilers. Booklet, "How to Select a Boiler."
119 *Cleaver-Brooks Co.

Plate Heat Exchanger.....Case history brochure details actual processing applications while catalog describes models ranging from 500 to 500,000 lbs/hr. capacity.
42-43 *De Laval Separator Co.

Steam Traps.....The 48-page book gives complete information and details on steam traps. Also information on design, construction & operation of Inverted Bucket Traps.
263 *Armstrong Machine Works

Steam Traps.....Type TD-50 can be used to control moisture content automatically. Other advantages include simplified piping, saved space, easy maintenance. Information.
132 *Sarco Company, Inc.

Steam Traps.....Series 30 is the steam trap for peak efficiency. Series 130 combines a Series 30 trap, a strainer & blow-down valve. New bulletin T-1743-B offered.
75 *Yarnall-Waring Co.

Instruments & Controls

Alarm Indicating Monitor.....offers centralized monitoring of all important variables. The AIM is fast, reliable and compact. Further information is available.
139 *Hagan Chemicals & Controls

Chlorinator.....V-notch chlorinators provide the economical answer to water- and waste-treatment problems. More information is available on request.
273 *Wallace & Tiernan Inc.

Control Center.....New SpaceMaker control center is the first completely new 2- to 5- kv. motor controller in more than a decade. Further details are available.
48-49e *Allis-Chalmers

Controls.....A wide variety of heavy duty controls for either pressure or temperature applications are available. Detailed information may be had upon request.
61c *American-Standard

Controls.....ElectriK Tel-O-Set system has many features that save time in getting on stream, and keep maintenance to a minimum. No external power is required.
14-15 *Minneapolis-Honeywell

Feeder.....Merchen feeder gives you greater feeding accuracy because of its sensitivity. It is compact & gives you hour-to-hour accuracy for feeding & blending. Inform.
272 *Wallace & Tiernan, Inc.

Gage.....Liquid level gage sets guarantee clearer visibility, unmatched accuracy at temperatures from sub-zero to 750°F. Complete information available.
247 *Penberthy Manufacturing Co.

Gauges.....Dial-type gauges show tank contents at-a-glance. Available to measure and indicate virtually any liquid at tank site or remotely. Literature.
253 *The Liquidometer Corp.

* From advertisement, this issue

LITERATURE . . .

Industrial Thermometers.....provide extreme accuracy, are hermetically sealed and can be externally calibrated. Detailed information is available on request.
61a *American-Standard

Instruments.....The complete story on this line of instruments, both pneumatic and electronic is contained in Bulletin 13-18 which is available.
44-45 *The Foxboro Company

Level Control.....Electr-O-Probes are capacitance-actuated super-sensitive electronic relays. For a variety of applications. Bulletins are available.
TR314 *Instruments, Inc.

Level Switches.....designed for open or pressurized systems. Feature extreme resistance to demagnetization and multiple switching functions. New folder RC-765 is offered.
243 *Robertshaw-Fulton Controls

Liquid Level Control.....The operating principle of Magnetrol is based on the proper use of a permanent magnet. Further information is available on request.
TL313 *Magnetrol, Inc.

Metered Flow Control.....will automatically measure and transfer with great accuracy at capacities to 100 G.P.M. Details may be had upon request.
234 *Waukesha Foundry Co.

Pneumatic Transmitter.....The 273 offers the widest differential pressure ranges, the highest safe working pressures & widest variety of housing materials. Data.
258 *Barton Instrument Corp.

Pulsation Snubbers.....are the most effective control measures available to eliminate pulse-induced vibration. Equipment performs better and operating costs are reduced.
280 *Burgess-Manning Company

Receiver.....New Series 670 Metagraphic receivers measure only 7" wide by 7⅛" high on panel and come in a wide selection of models. Complete data are available.
142 *The Bristol Company

Rotameters.....How measurement and control of flow rates in pipes as high as 48 in. can be done economically is described in bulletin prepared for engineers and designers.
285A Brooks Instrument Co. Inc.

Thermocouple Wells.....Nine basic types of standard pressure-tight wells, with or without T/C assemblies. Complete details in Catalog G100-5.
R288 *Minneapolis-Honeywell

Transducers.....Norwood transducers can be used wherever precision measurement of static and dynamic pressures are vital. Detailed information is available.
61b *American-Standard

Pipes, Fittings & Valves

Aluminum Pipe & Fittings.....A booklet describing aluminum pipe and fittings and their various applications and dimensions is available on request.
277a *Aluminum Co. of America

*From advertisement, this issue

KEY W CHEMICALS

Why caustic and chlorine are Key Chemicals at Wyandotte

Big volume? Long experience? Both count, and we have both. But far more significant than our total chlorine-caustic tonnage is the purity of every ounce of every order we ship. It's the highest. You can count on it: it's guaranteed. And long experience has full value only if it is put to work for the customer . . . ours is. May we put our experience to work for you?

WYANDOTTE CHEMICALS

MICHIGAN ALKALI DIVISION, WYANDOTTE, MICHIGAN

is the only way

There is no other way in which you can learn so much, so quickly about so many new developments than by visiting the fact-filled Exposition of Chemical Industries. To actually **SEE** and compare the new cost-saving products of over 500 manufacturers in one location will pay big dividends in new ideas that can be applied in your plant.

SEE what's new in process equipment, materials handling, chemicals and raw materials, laboratory equipment and supplies, control instruments and automation.

Keep informed—plan your visit now, and bring your associates with you. It will more than pay you for the modest investment in time. Write for free advance registration. 3001

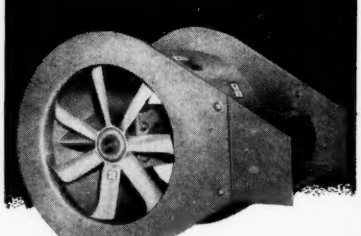
28th EXPOSITION OF CHEMICAL INDUSTRIES

N. Y. Coliseum, Nov. 27—Dec. 1, 1961

MANAGEMENT: International Exposition Company, 480 Lexington Ave., N. Y. 17, N. Y.

---

combat CORROSION the modern way . . .



with new

Aerovent

FIBER GLASS DUCT FANS

Featuring a unique built-in orifice and tear-drop shaped belt housing, Aerovent *Fiber Glass* Duct Fans are designed for your "*problem*" ventilating requirements. Virtually unaffected by normal concentrations of corrosion and most forms of chemical attack, *fiber glass* – used in the construction of the fan housing and other internal surfaces – assures longer, more dependable service in even the most difficult applications.

Propellers are stainless steel or Dura–a special alloy created by Aerovent for better resistance to corrosive atmospheres. Available in 17 models in sizes 14" to 42" for capacities to 32,500 cfm.

write for bulletin 175

All deliveries of all Aerovent equipment are tested and rated in accordance with established and accepted codes and each unit is guaranteed by the manufacturer to deliver its rated performance.

CERTIFIED PERFORMANCE

Aerovent Fans, Inc. *Aerovent*

FAN COMPANY, INC.

Ash and Bard Streets, Piqua, Ohio

ITERATURE . . .

Ball Valve.....Flo-Ball offers top entry, in-line maintenance, top & bottom guided ball, double seats, flanges integral with body and other features.
33-34 *Hydromatics, Inc.

Breather Valve.....The new Varec all-weather breather valve works perfectly in —60 deg. winter and +125 deg. summers. Complete information in Bulletin No. CP-2701.
153 *Vapor Recovery Systems Co.

Butterfly Valves.....Resilient seated butterfly valves save space, save weight, save cost and save trouble. Control may be manual or automatic. Bulletin 590X.
R292 *W. S. Rockwell Co.

Fittings.....are made to specifications which exceed the requirements of applicable A.S.T.M., A.S.A. & M.S.S. codes. Further information in Bulletin 416.
105 *Flowline Corp.

Fittings.....made from either seamless tubing or rolled plate. The story on these quality fittings is contained in Bulletin 60C which is available on request.
59 *Midwest Piping

Fittings & Valves.....Four bulletins list and describe complete line of 180 fittings and valves with engineering drawings, photographs and technical data.
287A Cherry-Burrell Corp.

Gate Valves.....New living wedge gate valves are available in 150 and 300 pound ASA ratings, 2″ to 24″. Details on these valves may be had upon request.
28-29 *Walworth Co.

Pinch Valve Systems....Massco-Grigsby Hydral-60 system consists of one or more pinch valves with a single automatically operated hydraulic pump. Catalog 609.
L290 *Mine & Smelter Supply Co.

Pipe.....safely handles 94% of known corrosive solutions. It is lightweight and no painting or maintenance is necessary. Further details are available.
261 *Fibrecast Company

Pipe.....Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200F. Information is offered.
124 *Saran Lined Pipe Co.

Pipe Product.....A technical report on Duotrace, a product which contains two trace passages a product passage integrally extruded in a single pipe is offered.
277c *Aluminum Co. of America

Piping & Tracing.....A bulletin describing Unitrace which combines piping and tracing in one unit is offered and may be had upon request.
277b *Aluminum Co. of America

Split-Body Control Valves.....A variety of split-body styles are available for more flow capacity. Information is contained in Bulletin S-B which is available on request.
36-37 *General Controls Co.

Tubes.....Condenser and heat exchanger tubes are available in over 50 metals and alloys along with Duplex tubes in various materials. Further information is offered.
152 *Bridgeport Brass Co.

* From advertisement, this issue

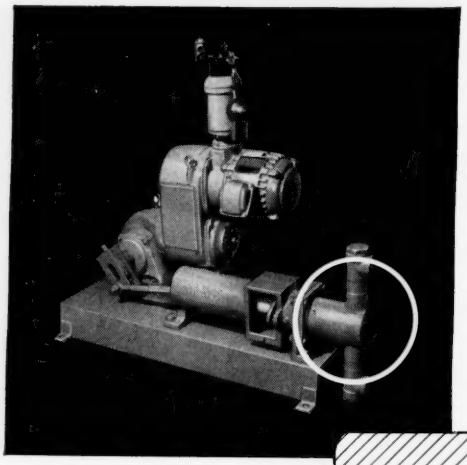
Key Chemicals from Wyandotte

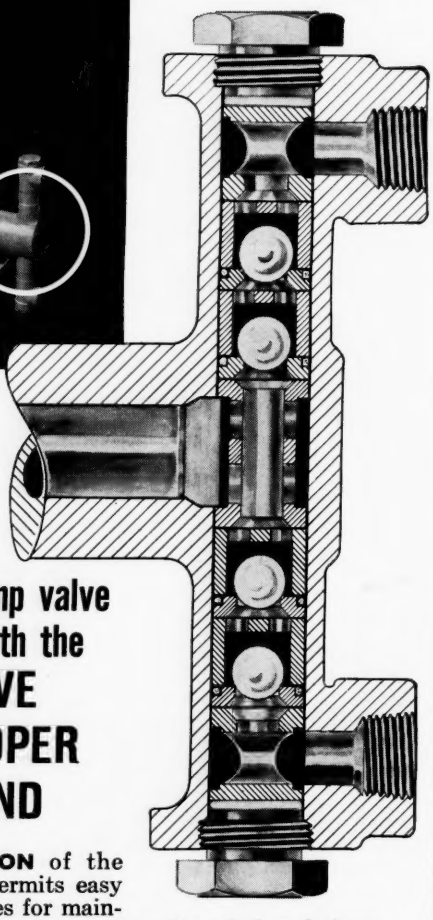
caustic and chlorine for the North

Every railroad, highway, and seaway in the North leads to Wyandotte's plant on the hub of the Great Lakes . . . or to a strategically located storage point. Users pick their mode of shipment for its most economical cost and convenience. Big volume and long experience have made caustic and chlorine Key Chemicals at Wyandotte. That means made right . . . and shipped right for you. Let us serve you.

WYANDOTTE CHEMICALS

MICHIGAN ALKALI DIVISION, WYANDOTTE, MICHIGAN





Cut metering pump valve maintenance with the EXCLUSIVE CLARK-COOPER LIQUID-END

DROP-OUT CONSTRUCTION of the Clark-Cooper liquid-end permits easy removal of ball check valves for maintenance and inspection. Simply unscrew threaded end-plugs. No need to disturb suction or discharge lines.

HIGH, REPRODUCIBLE VOLUMETRIC EFFICIENCY of Clark-Cooper Metering Pumps is achieved through individual valve units consisting of a ball, seat and cage. Units are self-aligning, interchangeable and self-cleaning. Flow passages are unrestricted, service life is longer, closure is consistently firm and effective.

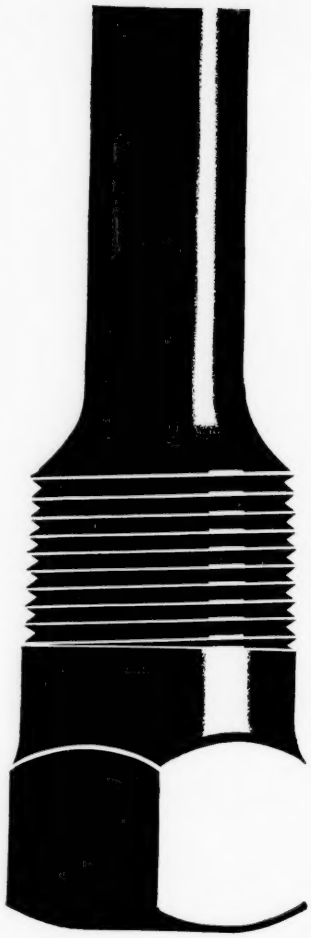
FACTORY ACCURACY is assured when check seats or balls must be replaced in the field. Only Clark-Cooper precision balls, seats and cages guarantee an automatic return to factory volumetric accuracy every time.

LOW N.P.S.H. REQUIREMENTS of Clark-Cooper Metering Pumps make them ideal for handling liquids at or near their boiling points, or liquids of high vapor pressure.

If you require additional information on Clark-Cooper Metering Pumps, we will be happy to supply it. Better yet, specify a C/C Pump on your next pumping application. See for yourself the many benefits it provides in actual operation.

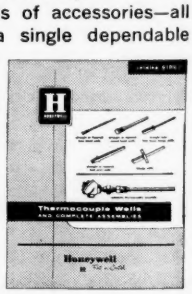
Available in a variety of materials for any corrosive application.

CLARK-COOPER DIVISION
FREDERIC B. STEVENS, INC.
Palmyra, New Jersey
REPRESENTATIVES IN ALL PRINCIPAL CITIES



THERMOCOUPLE WELLS

Nine basic types of standard pressure-tight wells, with or without T/C assemblies, and any type of special wells made to order. All are beta-gage checked for concentricity. Thermocouple wells are among thousands of accessories—all available from a single dependable source—that can help your instruments perform at their very best.



Get complete details from your nearby Honeywell field engineer, or write today for Catalog G100-5.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

Honeywell
First in Control
SINCE 1885

LITERATURE . . .

Tubes.....Stainless steel pressure tubes to handle super critical steam at 100 m.p.h. They are the answer to many high temperature-pressure problems.
455 *Timken Roller Bearing Co.

Tubing, Welded Steel.....Prevent corrosion when the pressure's on with welded stainless steel tubing. Available in Schedules 40S, 10S & 5S. Booklet 8591.
138 *Welded Steel Tube Institute

Valve.....The completely new design No. 23 sampling or drain valve has a reciprocating stem to eliminate galling at seat surfaces. Details in No. 23 Valve Catalog Sheet.
296 *Jerguson Gage & Valve Co.

Valve Manifolds.....RegO safety relief valve manifolds cost far less to buy, far less to maintain. Pop-action design keeps product loss to a minimum.
259 *The Bastian-Blessing Company

Valves.....made from Aloyco 20, a stainless alloy of exceptional versatility. Resistant to a broad range of acids as well as alkalies, to help with your corrosion problem.
78 *Alloy Steel Products Co.

Valves.....for the control of hot, cold, erosive, corrosive or viscous fluids. Designed to accept all standard actuators. General Catalog 1500-E is available.
229 *The Annin Company

Valves....Applications, features, operation, schematic drawings and prices of 15 solenoid valves given in 16 page catalog "Condensed Valve Supplement."
289A Automatic Switch Co.

Valves.....Bulletin 15-9 provides information on proper sizing of valves for any application in throttling flow of extremely abrasive slurries or liquids.
289B Clarkson Co.

Valves.....New 8", 10" and 12" Teflon-sleeved, non-lubricated plug valves are now available. Also available in bottom-entry, 3-way design & choice of metals.
107 *Continental Mfg. Co.

Valves.....The right valves for any chemical installation offering a complete line of valve materials, both ferrous and non-ferrous. Information.
113 *The Wm. Powell Company

Valves.....Ram type drain valves are designed so that in the closed position the piston or ram extends up into the tank. In open position full flow is assured. Cat.
TL255 *Strahman Valves, Inc.

Valves.....Gate, Globe and Check valves with hard faced seats feature interchangeable parts. Complete line of pressures, sizes & types. Literature.
166 *Henry Vogt Machine Co.

Valves.....These valves are made to specification, machined from solid stock (not cast) using best alloy steels. Plates are machined (not stamped) for close tolerance fit.
TL299 *J. H. H. Voss Co., Inc.

Valves, Ball.....A new catalog contains 32 pages of data on the newest, finest valves for corrosive & non-corrosive services and is available on request.
70 *Hills-McCanna Co.

*From advertisement, this issue

Key Chemicals from Wyandotte

caustic and chlorine for the South

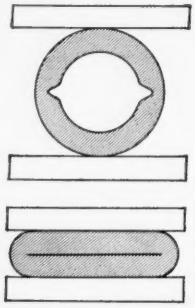
By barge, rail, truck, or over the fence, Southern users can now draw on the capacity of Wyandotte's new Geismar plant. 335 tons of chlorine, 385 tons of caustic per day . . . produced with the same care that has made chlorine and caustic Key Chemicals at Wyandotte. We can ship economically and with dispatch. Which method of shipment is best for you?

WYANDOTTE CHEMICALS

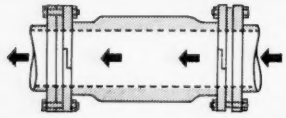
MICHIGAN ALKALI DIVISION, WYANDOTTE, MICHIGAN

Massco-Grigsby PINCH VALVES

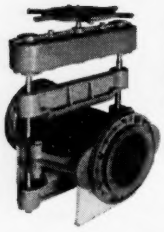
"Hinged" sleeve permits tight closing reduces wear.



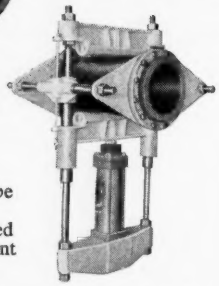
Recesses in sleeve serve as "hinges" during compression.



Unobstructed flow eliminates high friction loss; and there are no metal parts in contact with pulp or liquid.



Several types of closing mechanisms are available, from handwheel to motorized.



Automated Systems.
Completely automatic systems may be coordinated and interlocked with other plant equipment.

1" to 14" I.D.; pressures to 150 psi; temperatures to 200° F.

WRITE FOR CATALOG 609

MINE AND SMELTER SUPPLY CO.

3800 RACE STREET • DENVER, COLORADO
OFFICES AND AGENTS IN PRINCIPAL CITIES

LITERATURE . . .

Valves, Control.....LB control valves feature tight shutoff, simplified construction, lower maintenance, split body, fast delivery and much more. Literature is offered.
64 *Conoflow Corp.

Valves, Diaphragm.....resist attack by hot corrosives. The diaphragm lifts high for streamline flow-seals tight for positive closure. Further information.
148 *Grinnell Company

Valves, Emergency Relief.....provide emergency relief capacity beyond that furnished by operating vent. Weatherhood protects entire valve. Further information in "Blue Book".
241c *The Protectoseal Co.

Valves, Safety Relief.....have a special "O" ring seat seal that stops leakage completely. Available in both Standard & Balanced Bellows design. Cat. 1900 & Bul. 1940.
82 *Manning, Maxwell & Moore, Inc.

Valves & Fittings.....Ductile iron valves and fittings feature unbeatable performance, substantial savings on initial cost and lower maintenance costs. Catalog.
131 *Stockham Valves & Fittings

Process Equipment

Air Separators.....offer precise separation and improve screening. Increase 40 to 400 mesh output as much as 300%. For further information Bul. 087 is offered.
R290 *Sturtevant Mill Co.

Centrifugal.....The Batch-O-Matic handles greater out-of-balance loads with minimum vibration because of its low, compact design & exclusive center-slung suspension. Bul.
237 *American Machine & Metals, Inc.

Centrifugal Systems.....effect accurate continuous and controlled separation required in the manufacture of a wide range of products. A complete line.
56-57 *The Sharples Corp.

Continuous Mixers.....provide higher production rates with less equipment, allow proper instrumentation for better process control. A catalog is offered.
141 *Falls Industries, Inc.

Dissolvers.....for use with any product requiring mixing, dissolving, dispersing, emulsifying or deagglomerating. Further details are available on request.
L274 *Morehouse-Cowles, Inc.

Dryer.....Rotary Steam Tube Dryers engineered to dry 264,000 lbs. per day, are described in Catalog A. Also covers pressing, drying and cooling problems.
TR296 *Davenport Machine & Fdry. Co.

Dryer.....and fully integrated adsorption systems for every need. A new booklet, "Moisture Is Your Problem", contains the latest facts on moisture control.
TR274 *Kahn and Company, Inc.

Dryer.....keeps instrument and tool air desert dry. Case history sheets illustrate in details specifications & solutions to a multitude of moisture problems.
312 *Pittsburgh Lectrodryer Div.

* From advertisement, this issue

Size Requireme Getting Tough

Sturtevant Air Separat Increase 40 to 400 M Output as Much as 30

Closed-circuit air separation proved advantage in reduction proc Result is a better, more uniform pro Grinding mills perform at top effici output frequently increases as mu 300%, power costs drop as much as

Precise separation of all powdered materials. Sturtevants rently classify sulfur, soybeans, phate, chocolate, feldspar, sand an gregates, pigments, limestone fl flour, abrasives, plastics, gypsum, ce ics, cement and other products.

Improve screening — St vant Air Separators prevent blindin removing undesirable tailings *or* from screen feed loads.

Works Like Winnowin Done in a Whirlwind

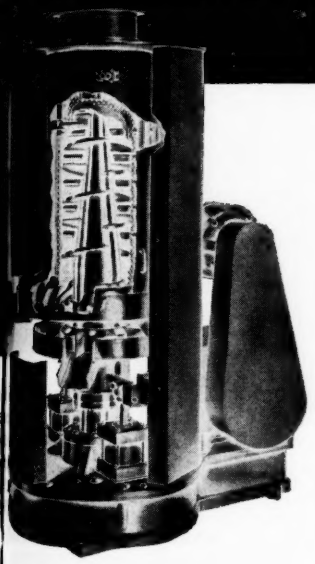
Sturtevant Air Separators do a mec ical job of winnowing. Precise contr whirlwind air currents and centri force results in the desired size l lifted into fines cone, oversize falling tailings cone.

A 16 ft. Sturtevant, for example, taken a feed rate of 800 tph, contai only a *small* percentage of desired f and delivered 30 tph 90% 200 mesh circulating the oversize through grinding circuit.

Send for Bulletin No. 087.

STURTEVANT MILL COMPANY
100 Clayton St., Boston, Mass.
Crushers • Grinders • Micron-Grinders • Separ
Blenders • Granulators • Conveyors • Elevat

DEMAND INCREASES FOR ZENITH PRESSMASTER



ecause . . .

S CONTINUOUS — completely automatic . . . self-adjusting . . . no operator.

S VERSATILE — extracts fluids from tually all fluid yielding solids.

S ECONOMICAL — greater production lower horsepower . . . better product near zero maintenance.

S DEPENDABLE — uniform product . . . her extraction . . . 24 hour a day, year-und operation.

S SANITARY — anti-bacterial design quick cleaning . . . product contamination eliminated.

For full information CALL COLLECT:

ith Press Division, Hillcrest 3-4411, Ext. 502
Pittsfield 4, Massachusetts

JONES CORP. member BELOIT group PITTSFIELD MASS.

Jones

ZENITH PRESS DIVISION

LITERATURE . . .

Dust Control Equipment.....works quickly and efficiently to reclaim valuable dust for you. Equipment for all your needs is available. All the facts on request.
109 *Pangburn Corp.

Dust Filter.....The new "RJ" is now available in 5 sizes for handling from 300 to 6400CFM of air (for larger capacities, multiples groupings are furnished). Bul. G-30.
268 *The Day Co.

Evaporators.....are made in six basic types—Rising Film, Forced Circulation, Falling Film, Agitated or Wiped Film, Rising-Falling Film and Calandria. Bulletin No. 393.
154 *Blaw-Knox

Evaporators.....An eight page treatise, Forced Circulation Evaporators, on salting and non-salting types, single & multiple effects is offered. Bul. SW205.
252 *Swenson Evaporator Co.

Exchangers.....for acetic acid distillation. They condense acetic vapors and cool the resultant liquid. Further information on this equipment on request.
316 *Goslin-Birmingham Mfg. Co.

Feeding Systems.....Continuous feeding/blending saves material, reduces costs, controls quality & results in bigger processing profits. Facts booklet offered.
R317 *B-I-F Industries

Filter.....EimcoBelt continuous belt filters successfully handle slurries that have always been considered impossible for vacuum filtration. Bulletin FE-2053 is offered.
Cover *Eimco Corp.

Filter Press.....can be used for a multitude of applications—go from one chamber to full capacity. The Sperry Catalog is available for information.
123 *D. R. Sperry & Co.

Filters.....A new design in cloth belt discharge filters features high capacity, wide size range, rigid drum construction and accessories. Technical data are available.
235 *American Machine & Metals, Inc.

Filters.....Details on how custom engineered Niagara filters can help with your problems is contained in Bulletin NC-457 which is available.
236 *American Machine & Metals, Inc.

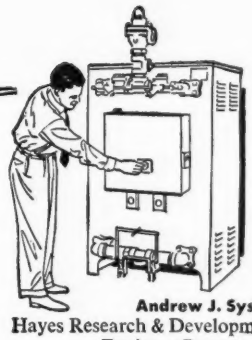
Filters.....Multi-Bag filters in a wide range of standard sizes permit engineering to meet almost any dry collection requirement. Information on these & other units.
245 *Dracco Div. of Fuller Co.

Flash Drying Systems.....offer flexibility in application. This is a versatile system that can be readily adapted to your particular problem. Catalog #82E.
164 *Combustion Engrg. Inc.

Gas and Liquid Drying.....The Molecu-Dryer for your many new drying needs. A comprehensive picture of the Molecu-Dryer is contained in Bulletin 5703.
R291 *C. I. Hayes, Inc.

Generators, Inert Gas.....offer precise fuel control & automatic safety. If you need inert gases for blanketing, purging & protective uses, see Bulletin L-10.
80 *The C. M. Kemp Mfg. Co.

* From advertisement, this issue



Andrew J. Syska,
Hayes Research & Development Engineer Reports . . .

KNOW-HOW IS VITAL IN GAS AND LIQUID DRYING

When we developed the Molecu-Dryer®—a unit specially designed to take advantage of the remarkable drying, sweetening, and purifying capabilities of Linde Company's Molecular Sieves—our chief interest was in drying protective atmospheres (hydrogen, dissociated ammonia, etc.) for metallurgical work—to dewpoints well below –100°F. A natural outgrowth of the Molecu-Dryer was the *Nitro-Gen*®—an automatic cycling generator which produces low cost, high purity nitrogen for blanketing, purging, protecting. Our engineering people have also explored whole new worlds of gas, liquid, and atmosphere drying and separating problems.

NEW DRYING NEEDS APPEAR DAILY

In manufacturing transistors, for example, the Molecu-Dryer has been able to effect big economies by supplying moisture-free air in place of tank nitrogen to protect transistor assembling and sealing operations. Other current projects: instrument air drying, gaseous CO_2 drying, gas separating . . . also drying and separating of liquid or gaseous hydrocarbons.

EQUIPMENT DESIGN IS DYNAMIC!

Each new area of work has necessitated engineered application of standard or special Molecu-Dryer models, to provide optimum adsorption efficiency, top capacity at minimum equipment cost, job-coordinated cycle times, and fast desorption and cooling.

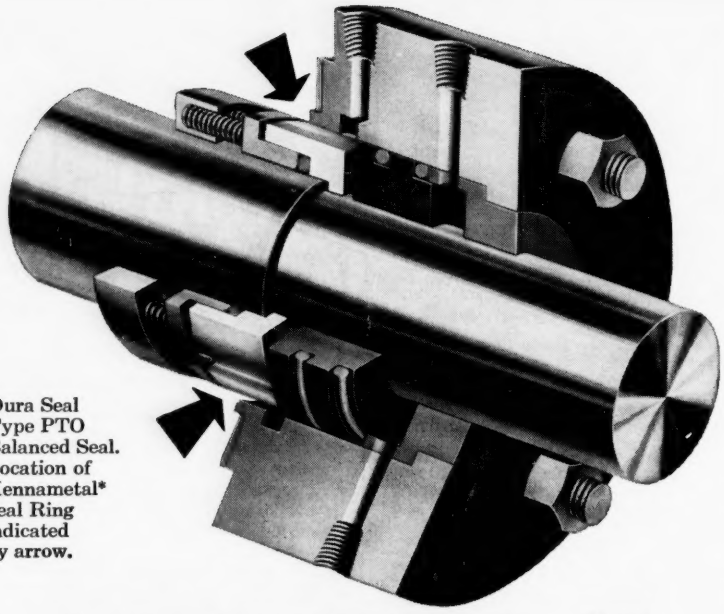
Linde TRADE MARK MOLECULAR SIEVES ®

For a comprehensive picture of the Molecu-Dryer, write for Bulletin 5703. *Hayes TM

C. I. HAYES, INC.
843 Wellington Avenue • Cranston 10, R. I.
Established 1905

ELECTRIC FURNACES

It pays to see Hayes for metallurgical guidance, lab. facilities, furnaces, atmosphere generators, gas and liquid dryers, Pow-R-Trol (TM) control units.



Dura Seal Type PTO Balanced Seal. Location of Kennametal* Seal Ring indicated by arrow.

It's tough to seal ethylene . . . but it can be done with KENNAMETAL

Single mechanical seals for ethylene and other light hydrocarbons must operate for several minutes at a time in vapor, without benefit of liquid lubrication. The seal and mating faces must therefore be able to operate virtually dry during these periods, at pressures up to 600 p.s.i., without damage to the seal faces.

For this difficult sealing job, Durametallic Corporation has found Kennametal Seal Rings superior to either cast alloy or ceramic rings. Kennametal rings can operate successfully with a minimum of lubrication. Kennametal stands the additional loading imposed by these adverse conditions. provides stability under high temperatures, and resists thermal shock.

On one ethylene pumping application, several "Dura Seals" with Kennametal rings have been operating for well over a year. Customer satisfaction has led to the purchase of additional seals for similar use.

To seal gases, exotic fuels, fluids, slurries, acids, basic solutions, synthetic and petroleum base fuels, organic solvents, butyl extracts . . . *Specify Kennametal* for exceptionally good dimensional stability, for successful sealing of a great variety of media, for strength without great mass, for corrosion and wear resistance, and for high temperature applications.

Send for these booklets: B-111-B—"Properties of Kennametal" and B-666—"Proven Uses of Kennametal and Kentanium.*" Write Dept. CE, KENNAMETAL INC., Latrobe, Pennsylvania.

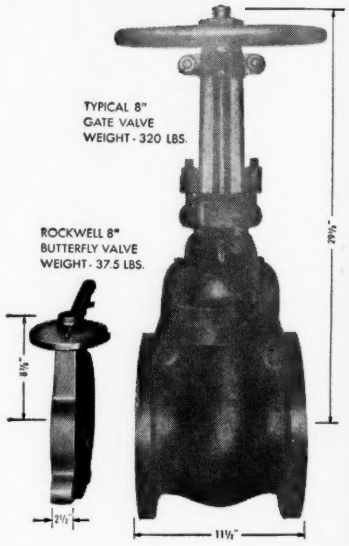
Note: Kennametal Inc. makes seal *rings* used by leading manufacturers of seals.

*Kennametal is the registered trademark of a series of hard carbide alloys of tungsten, tungsten-titanium and tantalum. Kentanium is the registered trademark for one of the series that has special advantages for applications requiring a lighter weight material and/or exceptional stability at temperature extremes.

33549

INDUSTRY AND
KENNAMETAL
. . . Partners in Progress

Compare them
✓ for Weight
✓ for Space

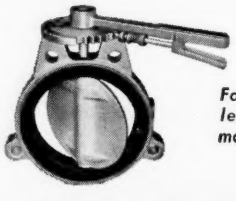


This Rockwell resilient-seated wafer butterfly valve and the large gate valve are both 8" pipe size. Both do the same job. But what a difference in weight, space—and cost.

What does this mean? It means a 60 to 80 per cent reduction in weight in favor of the butterfly valve, depending on size.

As for space, the 8" butterfly valve requires but 8⅜" from center line of pipe for clearance, whereas the gate valve requires over 37" from center line for clearance, when the valve is open.

There are other advantages, too: A quarter turn opens and closes the butterfly valve. The gate valve, however, requires many turns. And operation is easier; maintenance is lower.



Fact-packed Bulletin 590X tells more. Write for it.

W. S. ROCKWELL COMPANY
2300 Eliot St. • Fairfield, Conn.
Made and sold in Europe by
COCKBURNS, Ltd., Glasgow S.W.2, Scotland

LITERATURE . . .

Gravity Filter.....Bulletin WC-130 describes construction, operation and applications of fully automatic gravity filter with a single, simple control valve.
293A Graver Water Conditioning Co.

Grinding Mill.....The "Electric Ear" cuts grinding costs. Details on this unit are contained in Catalog No. 42-A-11 which may be had upon request.
266 *Hardinge Co, Inc.

Gyratory Screen.....features stacked-deck design to conserve valuable space. Cuts maintenance and downtime with all-stainless steel construction. Details.
48-49a *Allis-Chalmers

In-Line Blending System.....mixes fluid right in a pipeline. Eliminates batch mixing, holding tanks, and give great accuracy. Many types of systems are available.
205 *Fischer & Porter Co.

Mills.....Complete information on "Jet-O-Mizer" mills, "Jet-O-Clone" dust collectors and testing and custom grinding services is now available on request.
256 *Fluid Energy Processing & Equip.

Mixers.....Dispersator mixers with the patented "Micro-Shear" head feature: double shearing, balanced operation at much higher speeds than conventional mixers, etc.
BR296 *Premier Mill Corp.

Mixing Equipment.....Eureka precision mixing equipment for accuracy, economy and cleanliness in your blending. A catalog is offered giving details.
298 *S. Howe Company, Inc.

Plastics Processing System.....All the well known advantages of continuous processing have been adapted to compounding polyolefins and other plastics.
137 *Baker Perkins Inc.

Pressmaster.....dewaters virtually all fluid yielding solids, maintains uniform product, high yields. Further information is available on request.
L291 *Zenith Press Division, E. D. Jones

Process Equipment.....The Turbulizer features heavy steel shell with machined interior, heavy duty outboard bearings, etc. Complete details on request.
310 *The Strong Scott Mfg. Co.

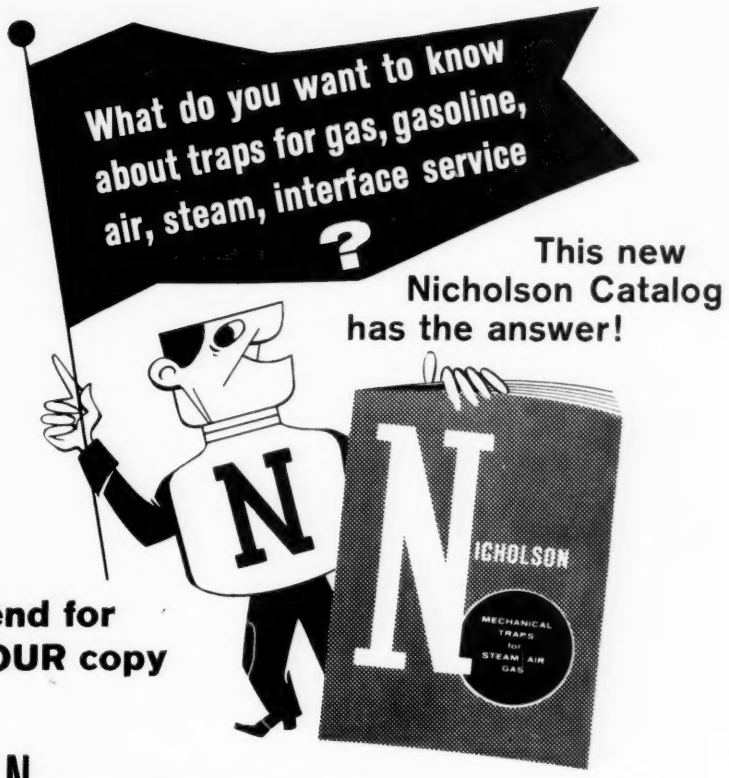
Purifiers.....Hi-eF purifiers can be relied upon to give outstanding performance. Bulletin 804 contains specifications on standard type plus engineered units.
BR300 *The V. D. Anderson Company

Raschig Rings.....The lower packing factor results in lower pressure drop which means greater capacity for your tower. Feature long service life in corrosive service.
84 *U. S. Stoneware

Refrigerated Filter.....Refrigifilter is a refrigerated packaged unit consisting of filter, separator, condenser, heat exchanger & automatic trap. Bulletin 902.
254 *Hankison Corp.

Roller Mills.....with exclusive gearless & spur gear drives. Quality fine grinding . . . 20 mesh to 400 mesh . . . micron sizes on some materials. Catalog.
227 *Williams Patent Crusher

*From advertisement, this issue


What do you want to know about traps for gas, gasoline, air, steam, interface service ?
This new Nicholson Catalog has the answer!
Send for YOUR copy
N
ICHOLSON
MECHANICAL TRAPS for STEAM AIR GAS

Nicholson intermittent-action mechanical traps . . . *how* they function . . . *where* they're used . . . *what* they're made of . . . *why* their exclusive Nicholson features mean longer service life, more efficient, economical trapping. Catalog 500 gives you that information . . . in factual, easy to read style . . . with sectional illustrations . . . dimensional diagrams . . . capacity tables . . . plus, a section showing how to determine the right trap size for your needs. It describes:

WEIGHT OPERATED TRAPS for gas, gasoline, air or steam service, pressures from atmospheric to 1500 pounds.

PISTON OPERATED TRAPS for steam applications where tremendous trap capacity is required.

INTERFACE TRAPS for applications where a liquid of heavy specific gravity must be separated from a lighter liquid.

Send coupon for *your* copy.

W. H. Nicholson and Co., 12 Oregon St., Wilkes-Barre, Pa.
Please send Catalog 500 "Mechanical Traps for Steam, Air, Gas."
Name_____
Title_____
Company_____
Street_____
City_____ Zone____ State_____

W. H. NICHOLSON and COMPANY
12 Oregon Street • Wilkes-Barre, Pa.

Our 80th Year

WEIGHTLESSNESS MAY BE A FACTOR IN OUTER SPACE...

but on Earth

TOLEDO SCALES

FILL AN EXPANDING NEED FOR BETTER WAYS TO CONTROL COSTS, INCREASE PROFITS

Materials become money, on your scales. And with materials up in cost, and profits under pressure, you need complete, accurate weight records now more than ever before. Without them, a vital ingredient for effective control of costs, inventories and quality is missing . . . and the door is open to serious losses. This is why so many management men are taking a fresh look at weighing.

It is especially important to re-evaluate weighing operations if you've made changes in plant layout, materials handling methods or inventory controls. In *any* of these areas, scales that don't fit the job may throttle production and infect weight records with costly errors.

Let us help you check weighing efficiency in your operations. A few minutes at each weighing station will give you valuable information on scale capacity and location, dial visibility, platform size and height, weight records and other key factors. Write TOLEDO SCALE, Division of Toledo Scale Corporation, Toledo 12, Ohio.
(*Toledo Scale Company of Canada, Ltd., Windsor, Ontario*)

Complete, Full-figure Printed Records with Toledo Printweigh® "400". Takes the "human element" out of weighing, and so eliminates errors in reading, remembering and recording weight data. Prints weights in full figures on tickets, sheets or strips. Will transmit weight data electrically for recording at remote locations. Ask for Bulletin 2017.

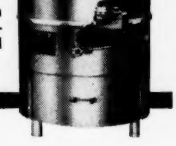
SERVICE
Factory-Trained
240 Cities

TOLEDO® *Headquarters for Weighing Systems*

"Sicon *does not discolor under intense heat...*"

Left, Model ESO-1 Majestic Incinerator with smart finish of Sicon Blue-Gray.

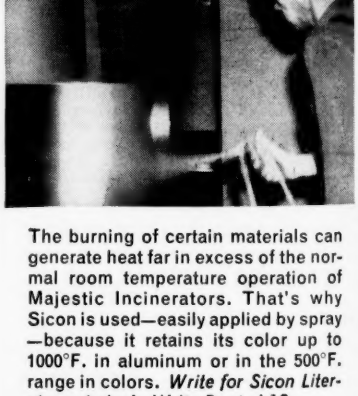
Below, Model C finished in attractive Sicon Aluminum



Sicon finish is applied by spray on both models. Surface phosphatized by hand wiping.

—says Bob Cox, Sales Promotion Manager of the Majestic Company, Huntington, Indiana.

"Our laboratory testing has shown us," states Mr. Cox, "that Sicon fills our requirements for excellent color retention under high temperatures."



The burning of certain materials can generate heat far in excess of the normal room temperature operation of Majestic Incinerators. That's why Sicon is used—easily applied by spray—because it retains its color up to 1000°F. in aluminum or in the 500°F. range in colors. *Write for Sicon Literature—today!* Write Dept. J-10.

Sicon®

Silicone Hi-Heat Finish
by **MIDLAND**

Industrial Finishes Co.
Waukegan, Illinois

LITERATURE . . .

Separators.....Vibro-Energy separators offer quick screen change & longer screen life to cut operating and maintenance costs. Full details & application data are offered.
158 *Southwestern Engrg. Co.

Steam Jacketed Kettles.....meet every processing & mixing need. Size & type for every progess or product are covered in book of engineering data & specification sheets.
R313 *Goren Mfg. Co.

Tornado Mill.....offers versatility in speed, in size of particles it handles, & in the rate of production. The 360 degree screen provides full working area.
284 *F. J. Stokes Corp.

Vibrating Feeder.....Feeder offering a solid drive connecting rod controlling amplitude of stroke and insuring constant flow of material is described in bulletin 261.
295A Stephens-Adamson Mfg. Co.

Pumps, Fans & Compressors

Air Pumps.....“Oil-less” air pumps offer absolutely oil-free air delivery, no lubrication required. “Oil-less” bulletins may be had upon request for details.
TR300 *Gast Manufacturing Corp.

Centrifugal Fire Pumps.....give immediate protection against fire automatically, without human attention. Information is contained in Bulletin B-1500.
127 *Peerless Pumps

Compressors, Centrifugal.... Model G centrifugal compressors are available in capacities from 500 to 15,000 cfm, for 4 to 20 psig duty on air service. Bulletin 3229-11.
225 *Joy Mfg. Co.

Diaphragm Pump.....for those hard-to-handle fluids; corrosive, abrasive, viscous, thick, heavy, etc. Easy to clean. Bulletin 148 is available on request.
R283 *T. Shriver & Co., Inc.

Duct Fans.....Propellers are stainless steel or Dura, a special alloy created for better resistance to corrosive atmospheres. Details in Bulletin 175.
R286 *Aerovent Fan Co., Inc.

In-Line Submersible Pumps.....are made as small as 4 in. bowls on a 4 in. motor for use in a 6 in. pipe to deliver 30 GPM. Further information in Bulletin 203.
65b *Layne & Bowler, Inc.

Pump.....All-Chem rotary positive displacement pump for reduced viscosities and temperatures to 250 F, capacities to 10 gpm, pressures to 75 psi. Literature.
72a *Eco Engineering Co.

Pump....Type DPL self-priming pump gives assured performance and dependable, trouble-free economy. For your toughest jobs or routine applications. Details.
53 *La Bour Company

Pump.....Vacseal pumps are custom engineered for your pumping requirements. Exclusive impeller design eliminates gland leakage, sealing water is not required.
6 *The Galigher Co.

* From advertisement, this issue

FIVE-STAGE EVACTOR AND BOOSTER

NEW TEST CENTER for PROVING and IMPROVING EJECTORS

You are cordially invited to visit this new building devoted entirely to testing, development and research. Here you will see facilities as modern and complete as any existing for the testing of steam jet vacuum equipment.

Floor space and test blocks are sufficient to permit the simultaneous testing of a variety of equipment along with special testing of vacuum processing under actual operating conditions. To assist, we have a steam generating plant equipped with two boilers. one of capacity up to 25,000# per hour at 250# ga; the other, 4,000# per hour at 600# ga. Also: a 60,000-gallon cooling pond and assorted liquid pumps up to 3,000 gpm for both positive pressure and vacuum service; a 4,000 square foot surface condenser; a 6-ton hoist.

Under the same roof for use in research are other types of heavy equipment and laboratory instruments of most accurate design. All together, the facilities of our testing and research center give extra assurance that jet vacuum equipment, fume scrubbers and cooling units from Croll-Reynolds will perform exactly as specified.

CROLL-REYNOLDS

Croll-Reynolds CO., INC.

Main Office. 751 Central Avenue, Westfield, N. J.

Chill-VACTORS® • Steam-Jet EVACTORS® • Aqua-VACTORS® • Fume Scrubbers • Special Jet Apparatus

The New

JERGUSON SAMPLING or Drain VALVE *with RECIPROCATING STEM*

You get Freedom from Seat Galling and Stem Freezing in this newly improved self-draining Sampling or Drain Valve in the popular 1" size.

The completely new design Jerguson No. 23 Sampling or Drain Valve has a reciprocating stem which eliminates galling at seat surfaces, a special-type welded bonnet with OS&Y that prevents stem freezing, and stem-seating outside the valve body which makes it self-draining.

Perfect Seating; No Galling: Reciprocating Stem operates in to-and-fro motion with no rotating action. Gives perfect seating every time and eliminates seat galling.

No Stem Freezing: Stem works freely at all times as new design has simplified OS&Y welded bonnet; forged yoke supports stem away from valve body and separate forged gland-follower bears directly on packing independent of yoke.

Self-Draining: Valve Stem seats on outside valve body inlet; no liquid remains in nipple or valve.

Sizes; Pressures: Popular 1" male tank conn. with ¾" outlet (1" avail.); ½" plugged "steaming out" conn.; for 4000 lbs. @ 100° F. Many optional features. (1½" and 2" sizes, 600 lbs. press. available with all features except reciprocating stem).

Write for No. 23 Valve Catalog Sheet.

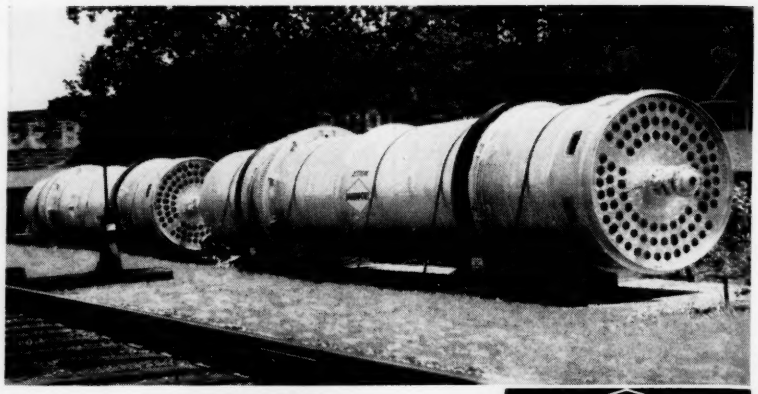
JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY

100 Adams Street, Burlington, Mass.

Offices in Major Cities



"TWIN DAVENPORTS"

Loaded and ready for shipment to a large mid-western grain processing plant for handling their drying requirements. Another "Davenport" dryer installation sized, designed and built for a particular drying job and years of productive service life.

Our Engineers will be happy to discuss your drying problems with you. Ask for our Catalog A and about our Pilot Plant Service. For quick reference, see your Chemical Engineering Catalog.

DAVENPORT MACHINE AND Foundry Company

A DIVISION OF MIDDLE STATES CORPORATION

Davenport, Iowa, U.S.A.

DAVENPORT

PRESSING — DRYING and COOLING Equipment

Continuous DeWatering Presses

ROTARY DRYERS Steam Tube, Hot Air and Direct Fire

Atmospheric DRUM DRYERS

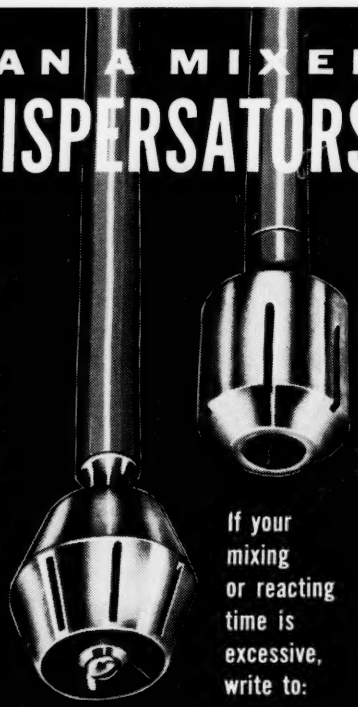
ROTARY COOLERS Water and Air

MORE THAN A MIXER

PREMIER DISPERSATORS

High speed—High shear ...for extremely rapid and thorough dispersion and solution.

The Premier Dispersator is capable of completing in minutes, or even seconds, many operations which take hours or days with conventional mixers. The secret, of course, is in the head. The patented design produces a double shearing action resulting in a complete wetting and breakdown of particle size . . . unobtainable with ordinary mixing devices.



If your mixing or reacting time is excessive, write to:

PREMIER MILL CORP., 224 Fifth Ave., N.Y. 1, N.Y.

BE SURE TO VISIT US AT THE CHEM SHOW—BOOTH NO. 941

LITERATURE . . .

Pump.....Moyno pumps for abrasives, corrosive or suspended solids. Available in nine sizes with capacities for 1/100 to 500 gpm. Bulletin 100-CE is offered.
79 *Robbins & Myers, Inc.

Pumps.....for applications where pressures are high and liquids are hard to handle. Complete data on the line of pumps are available on request.
159 *Aldrich Pump Company

Pumps.....Electri-Cand pumps are built without packing, stuffing box or seals—the unit is completely fluid tight. Safely handles a wide variety of fluids. Details.
48-49d *Allis-Chalmers

Pumps.....Acid pumps, centrifugal and gear types, protected by Ace Hard Rubber are described in Bulletin CE-55 which is available on request.
111 *American Hard Rubber Co.

Pumps.....Controlled capacity pumps for continuous, accurate metering of all types of liquids. Features exclusive liquid-end design. Information offered.
L288 *Clark-Cooper Div.

Pumps.....16-page booklet "Pump Fundamentals" gives an elementary outline of the characteristics, operation and selection of reciprocating, rotary and centrifugal pumps.
297A Goulds Pumps, Inc.

Pumps.....Triplex pumps save packing failure at high pressures. Available in 120 different cylinder designs to meet every product problem.
217 *Manton Gaulin Mfg. Co.

Pumps.....Minipumps assure precision pumping of small volumes of liquid. More detailed information is contained in Bulletin 1257-1 which is available on request.
4 *Milton Roy Company

Pumps.....Karbate frame-mounted Type F pumps have been added to the line of impervious graphite pumps. Details on models and sizes are available on request.
76 *National Carbon Company

Pumps, Metering.....for biological, industrial or sanitary use feature fixed or variable capacities and extremely compact design. Complete details & prices offered.
BR314 *Mechanical Products Corp.

Roof Ventilator Fan.....The Flip-Top roof ventilator cuts maintenance cost. Offers fan wheels from 12″ to 48″ in diameter & capacities to 43,070 CFM. Bulletin DR-7-61.
238 *American Machine & Metals, Inc.

Submersible Pumps.....are available for wells as small as 6 in. and in capacities from 30 GPM up. Additional information is contained in Bulletin 202.
65a *Layne & Bowler, Inc.

Services & Miscellaneous

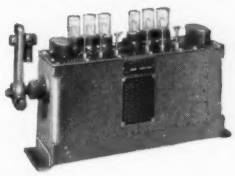
Casters & Wheels.....All types of rubber treads for smooth operation on all kinds of floors. A new manual is offered describing nearly 4,000 types.
R278 *Darnell Corp.

* From advertisement, this issue

How to STRETCH

a drop of oil...

Manzel force-feed lubricators squeeze the full potential out of every drop of oil you purchase. Model "94", for example, pumps against pressures up to 3,000 pounds, handling any grade of oil from the lightest mineral oil to the heaviest cylinder stock with the same regularity. Model "94" starts, stops, speeds up and slows down in synchronization with your machinery. Every change in engine speed brings a corresponding change in the amount of oil delivered. For details on our whole line of *responsive, responsible* lubricators, write for our catalog. Manzel, 250 Babcock Street, Buffalo 10, New York. For the most efficient lubrication,



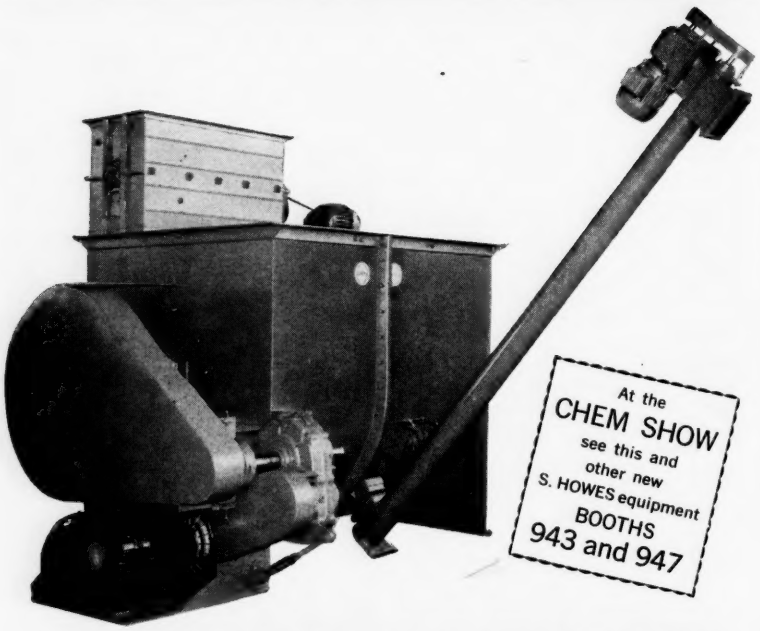
ask the man from

A UNIT OF HOUDAILLE INDUSTRIES, INC.

Manzel

SPECIALISTS IN LUBRICATORS AND METERING PUMPS SINCE 1898

IN THE CRUCIAL 60's



PUT NEW PRECISION IN YOUR MIXING

THIS SANITARY MIXER is typical of Eureka equipment being used throughout the processing industries. Custom-engineered for the Block Drug Company of Jersey City, N. J. in blending Polident cleansers, the unit is teamed with a Eureka Sifter and a Sanitary Screw Conveyor. Features include stainless steel construction, a specially-designed mixing cylinder, and extremely compact but powerful drive components.

YOU CAN ACHIEVE new standards of accuracy, cleanliness and economy in all your blending, aspirating, size reduction, weighing, packing and conveying operations, too...with precision S. Howes equipment.

EUREKA

AMERICAN MADE... YOUR BEST BUY

WRITE FOR CATALOG giving details of the full line of Eureka equipment for the processing industries.

S. HOWES COMPANY, INC. • SILVER CREEK, NEW YORK

GET FAST ACTION

CALL COLLECT, YELLOWSTONE 4-2611, Silver Creek, N. Y. for prompt, personal attention to any request.

LITERATURE . . .

Conservation Vents.....designed with flame arrester structure outside the vent housing. UL and FM approved and are made in a wide range of sizes. "Blue Book" offered.
241b *The Protectoseal Co.

Flame Arrester Vents....prevent flashbacks into tanks, process kettles, etc. through vent opening. Details in Vent Catalog which is available on request.
241a *The Protectoseal Co.

Hydrogen Cyanide Process....produces HCN from ammonia and hydrocarbon in a non-catalytic, oxygen-free reaction. Further details on this process are offered.
35 *The Lummus Company

Instrument Symbols.....bulletin "Suggested Flowsheet Instrumentation Symbols" includes piping and lines, solenoids and other valves, measuring elements and other process equipment.
298A Fischer & Porter Co.

Lubrication System.....Alemite barrel-to-bearing lubrication is a product and profit boosting production tool. The Alemite catalog is available.
69 *Stewart-Warner Corp.

Lubricator.....forces oil of any viscosity against the high steam, gas and air pressure so common in modern compressors, engines & machines. Catalog is offered.
297 *Manzel

Methane Plants.....are built to exacting standards and the application of Cryotechniques. Details are contained in Bulletin CH4-1M-61-3 which is available.
282 *American Air Liquid

Printed Weight Records....New Printweight "400" prints complete weight records on tickets or sheets, also on strips. Time & data printing available. Bulletin 2017.
294b *Toledo Scale Corp.

Professional Development.....A booklet, "Buyer-Seller Alliance" is another in the professional development for engineers and may be had upon request.
101 *Western Supply Co.

Seal Replacement.....8-page manual outlines mechanical seal replacement for both end mounted sealed and packed pumps and specifies tools and assembly instructions.
298B Roy E. Roth Co.

Storage Units.....Designed and fabricated to exactly meet your requirements. Welding know-how with aluminum, stainless and alloys for low temp. duty. Information.
77 *Pittsburgh-DesMoines Steel Co.

Waste Disposal.....Pyron system will thermally decompose more than 40 dangerous vapors & liquids common to industrial processing. A brochure is available for details.
117 *Avien, Inc.

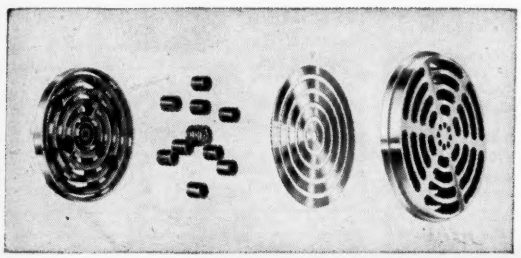
Waste & Refuse Storage.....Dumpmaster system features out-of-sight waste & refuse storage for your plant. You may own the system or secure service from a hauler. Brochure.
60 *Dempster Brothers, Inc.

Water Softener.....Zeolite water softener means a simple switch to sodium ions from the usual hardness present in water supplies. Further details are available.
48-49c *Allis-Chalmers

* From advertisement, this issue

VOSS VALVES will mean LESS MAINTENANCE FEWER SHUTDOWNS for your COMPRESSORS

Voss Valves are made to specification, machined from solid stock (not cast)—using best alloy steels; for corrosion condition—stainless steels, such as 410, 18-8 or non-ferrous alloys—monel, inconel, etc. Plates are machined (not stamped) and ground for precise close tolerance fit; are dimensionally stable . . . ductile . . . resist fracture, high temperatures and corrosion . . . withstand fatigue. Springs of heavy rectangular sections and large diameters add to dependability and safety.



- up to 40% more valve area
- minimum pressure loss
- higher efficiency
- less power consumption
- normal discharge temperature
- quiet, vibration-free
- utmost safety
- lower operating costs

For detailed proposal send name, bore, stroke and speed of machine.

J. H. H. VOSS VALVES REG. U.S. PAT. OFF.

J. H. H. VOSS Co., Inc.
785 East 144th Street,
New York 54, N. Y.

VITREOSIL®

PURE FUSED QUARTZ

FINEST QUALITY IN INDUSTRIAL WARE

- Absolute Chemical Purity
- Extreme Heat Resistance
- Thermal Shock Resistance
- Chemical Inertness
- Outstanding Electrical Properties
- Full Range Radiant Energy Transmission

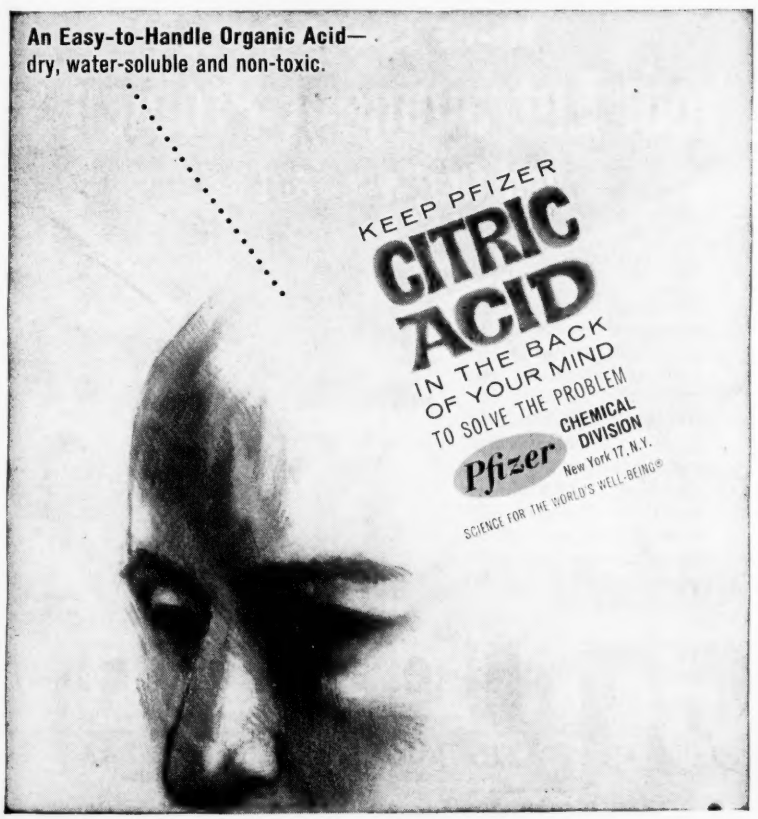
VITREOSIL easily meets critical production requirements . . . replaces more costly materials. Available in many types and sizes. Also fabricated to your special needs. See our ad in **Chemical Engineering, Electronic Engineers Master** and **Electronic Designers' Catalogues.**

Write for complete illustrated catalog.

VITREOUS SILICA — VITREOSIL

THERMAL AMERICAN FUSED QUARTZ CO., INC.
18-20 Salem St., Dover, N. J.

An Easy-to-Handle Organic Acid—
dry, water-soluble and non-toxic.



Discover why

NEVA-CLOG

Serves Better

as a

- RESIN RETAINER
- REGENERANT DISTRIBUTOR
- GRANULAR CARBON SUPPORT
- PRECOAT FILTER MEDIUM
- CENTRIFUGE LINER
- IMPINGEMENT SCREEN

Manufacturers and users by the score prove from hard experience that

1 —Serving as the carbon support in granular activated carbon towers, Neva-Clog bottoms are more efficient, rugged, rigid and longer lasting than woven media. No protective top screen is required.

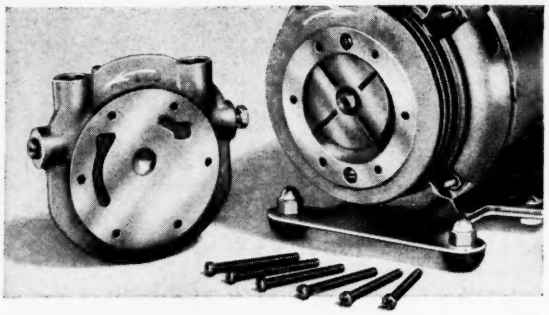
2 —As an underdrain in ion exchange units and demineralizers, Neva-Clog is a superior resin bed support; increases capacity; reduces rinse requirements; assures more uniform flow rate.

3 —On pressure or vacuum filter elements, Neva-Clog provides better drainage; is easier to scrape, sluice, backwash and clean than other filter media.

And there are many other amazing, successful applications in processing equipment!

Learn more about Neva-Clog's greater strength and durability, non-plugging and non-fouling characteristics and remarkable performance. Get this new Bulletin 613.

MM MULTI-METAL WIRE CLOTH CO., INC.
1353 GARRISON AVENUE, NEW YORK 59, N. Y.



NEED AN OIL-FREE AIR SUPPLY?

Select sizes from .35 up to 24 c.f.m.

Miniature Models

GAST OIL-LESS* AIR PUMPS

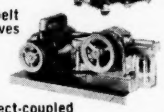
These Oil-less Air Compressors and Vacuum Pumps offer you:

1. Absolutely oil-free air delivery.
2. No lubrication required — no need to arrange access for oiling.
3. No oil to buy, no time spent in oiling.

Integral-motor Types

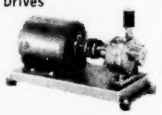
Carbon vanes in rotor lubricate themselves. Ball bearings are grease-sealed for life and located outside pump chamber. Pressures to 10 p.s.i.g., vacuum to 20" Hg.

V-belt Drives



*Lubricated models also available.

Direct-coupled Drives



WRITE TODAY FOR "OIL-LESS" BULLETINS.

AIR MOTORS • VACUUM PUMPS • COMPRESSORS

GAST MANUFACTURING CORP.
P. O. BOX 117-S . BENTON HARBOR, MICHIGAN

Hi-eF Can Solve

Your Entrainment Problems

and that's a fact . . .

Because Anderson engineers are specialists in solving problems involving carryover, entrainment or mist extraction. You can rely on every Hi-eF Purifier installation to give outstanding performance. Send for Bulletin 804 containing specifications on standard type purifiers, plus special engineered units.

TYPE IM
Upflow Internal

TYPE L
LINE

TYPE ID
Downflow Internal

TYPE LRV
RECEIVER

Hi-eF PURIFIER

By the Manufacturers of Super-Silvertop Steam Traps

THE V. D. ANDERSON COMPANY
Division of International Basic Economy Corporation
1943 West 96th Street Cleveland 2, Ohio

PROFESSIONAL SERVICES

THE KULJIAN CORPORATION

Consultants • *Consulting* • *Constructors*

Chemical • Industrial • Process

1200 N. Broad St. Phila. 21, Pa.

Offices Throughout the World

CHAS. T. MAIN, INC.

Engineers

Industrial plants

Reports Design Construction Supervision

Boston, Massachusetts Charlotte, North Carolina

UNITED INTERNATIONAL RESEARCH, INC.

Consultants in Chemical Research

38-15 30 St., Long Island City 1, N. Y.

READERS MAY CONTACT

the consultants whose cards appear on this page with the confidence justified by the offering of these special services NATIONALLY.

LEGAL NOTICE

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, JULY 2, 1946 AND JUNE 11, 1960 (74 Stat. 208) SHOWING THE OWNERSHIP MANAGEMENT, AND CIRCULATION

Of CHEMICAL ENGINEERING, published biweekly at Albany, New York for October 1, 1961.

1. The names and addresses of the publisher, editor, and business managers are: Published by McGraw-Hill Publishing Company, Inc., 330 West 42nd St., New York 36, N. Y.; Editor Cecil H. Chilton, 330 West 42nd St., New York 36, N. Y.; Managing editor, none; Business manager, Anton J. Mangold, 330 West 42nd St., New York 36, N. Y.

2. The owner is McGraw-Hill Publishing Company, Inc., 330 West 42nd St., New York 36, N. Y. Stockholders holding 1% or more of stock are: Donald C. McGraw, Elizabeth McGraw Webster, Donald C. McGraw, Jr. & Harold W. McGraw, Jr., Trustees under Indenture of Trust m/b James H. McGraw, dated 1/14/21 as modified; Donald C. McGraw & Harold W. McGraw, Trustees under an Indenture of Trust m/b James H. McGraw, dated 7/1/37 as amended; Donald C. McGraw, individually; Estate of Mildred W. McGraw, Donald C McGraw and Catharine McGraw Rock, Executors; (all of 330 West 42nd Street, New York 36, N. Y.); Grace W. Mehren, 536 Arenas St., LaJolla, California; Douglass & Co., 140 Broadway, New York, N. Y., Touchstone & Co., c/o Wellington Fund, Inc., Claymont, Delaware.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: 50,045.

McGRAW-HILL PUBLISHING COMPANY, INC.

By JOHN J. COOKE, Vice President & Secretary.

Sworn to and subscribed before me this 18th day of September, 1961.

[SEAL] JANET A. HARTWICK.

(My commission expires March 30, 1963)

Employment Opportunities

CE's nation-wide coverage brings you tips and information on current opportunities in job functions throughout the chemical process industries.

▶ **Displayed Rates**—$54 per inch for all ads except on a contract basis; contract rates on request. An advertising inch is measured ⅞ in. vertically on a column; 3 columns, 30 in. per page. Subject to the usual agency commission.

▶ **Undisplayed Rates**—$2.10 per line, 3 lines minimum. To figure advance payment count 5 average words as a line; box number counts as 1 line. 10% discount if full payment is made in advance for 4 consecutive insertions. Not subject to agency commission.

CHEMICAL ENGINEERS

(BS-MS-PhDs)

for Linde

. . . First in cryogenics and foremost producer of industrial gases and cryogenic equipment . . . immediate professional opportunities at its Engineering Laboratory in Tonawanda, for men with up to 5 years' engineering experience. These are permanent positions; strong interest and training in thermodynamics, heat transfer, fluid mechanics, strength of materials and thermodynamic processes, desirable.

CRYOGENIC PRODUCTS

Exciting new area requiring top technical personnel to invent and develop unique applications for cryogenic fluids and equipment in programs ranging from food preservation to space study.

BASIC ENGINEERING

Research and development in the above specified areas.

CREATIVE PLANT DESIGN

Process design, plant assembly and instrumentation, plant start-up and evaluation.

DESIGN AND DEVELOPMENT

Application, handling and distribution of acetylene and cryogenic fluids.

Please send resume to Mr. J. E. McMahon, Head of Employment, Dept. 3723. All inquiries will receive prompt and confidential attention.

LINDE COMPANY UNION CARBIDE

UNION CARBIDE CORPORATION

P. O. Box 44, Tonawanda, N. Y. (A suburb of Buffalo)

An equal opportunity employer

ENGINEERS

Immediate openings for qualified applicants familiar with chemical cleaning of process equipment or municipal/industrial water and waste treatment. Specific opportunities for:

SERVICE & SALES ENGINEERS
Degree in chemical or mechanical engineering. Prefer power-plant, chemical-plant or refinery experience in high-pressure steam generation; water, chemical and gas distribution; industrial processing equipment.

PRODUCT—SALES ENGINEERS
Degree required, preferably in engineering. Training or experience in chemistry, bio-chemistry or bacteriology acceptable. Background in waste treatment desirable.

Management recognition of initiative and ingenuity, unlimited opportunity for advancement. Group life insurance plus extensive major medical coverage. Unique retirement benefits.

Applicant must be willing to relocate and travel. Openings available nationwide. Individual preference for area assignments, if possible. Diversification of work assures full utilization of talent.

Mail resume to:
PERSONNEL MANAGER
DOW INDUSTRIAL SERVICE
Division of
The Dow Chemical Company
20575 Center Ridge Road
Cleveland 16, Ohio

CHEMICAL ENGINEERS

Challenging, diversified positions available in development department. Excellent opportunities involving process and plant investigation, pilot plant design and operation.

Experienced chemical engineers to fill challenging positions in production department. Assignments will involve development trouble shooting, product quality, production scheduling and personnel administration.

Requirement of B.S. or M.S. degree in chemical engineering.

Project engineer positions available for applicants with B.S. or M.S. chemical or mechanical engineering degrees.

These positions are permanent, created by expansion, with excellent opportunities for advancement. Plant and laboratories located in Chicago Heights, Illinois. Also, one production chemical engineer is required at our organic plant in Tennessee. Liberal employee benefits. Qualified applicants are invited to forward detailed resumes, stating salary requirements, to

M. C. McManus
VICTOR CHEMICAL WORKS DIVISION
STAUFFER CHEMICAL CO.
155 N. WACKER DRIVE
CHICAGO 6, ILL.

ENGINEERS

SENIOR PROCESS
SENIOR PROJECT

McKEE offers exceptional career opportunities to men qualified by experience with engineering contractors engaged in the design and construction of petroleum, chemical and petrochemical plants.

Send detailed resume to:
G. VICTOR HOPKINS
ARTHUR G. McKEE & CO.
2300 Chester Ave. Cleveland 1, Ohio

REFINERY CHEMICAL ENGINEERS

CARIBBEAN AREA

Desired for opportunities in a large modern refinery of the Lago Oil & Transport Company, Ltd., in Aruba, Netherlands Antilles, an affiliate of STANDARD OIL COMPANY (N.J.). Candidates must be graduate Chemical Engineers with 3 to 5 years refinery experience and a working knowledge of refinery processes for performance analysis, design and economy evaluation of the operation of a major refinery. Possibilities for later assignment to Economics and Programming Group. Liberal employee benefits including home vacations with travel allowances. Interviews will be arranged for qualified candidates. All replies confidential. Send complete resume of work experience and personal data to:

P.O. Box 518
Department E
Radio City Station
New York 19, New York

WANTED
Electrical, Mechanical or Chemical Engineering Graduates

. . . to be trained as Sales Engineers for Cleveland, New York, Chicago, and Richmond, Virginia. We also have an opening for man with technical background for inside office work at Los Angeles. Prefer men between 25 and 32 years of age who have had industrial process experience. Successful applicants will be given a three month factory course starting February 1, 1962.

Write Harry E. Beane, Vice President
THE BRISTOL COMPANY
Waterbury 20, Connecticut

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 645 N. Michigan Ave.
SAN FRANCISCO 11: 255 California St.

SELLING OPPORTUNITY WANTED

Wanted — Manufacturer's Rep., located in Cincinnati; desires lines for chemical, paint, food, and beverage industry. Reply RA-7607, Chemical Engineering.

Representative Available. Argentina, Uruguay, registered engineer, U. S. citizen, W/ offices D. T. Buenos Aires, wants representation Engineering Const. Co and Manufacturers. Available interview U. S. during October. Address RA-7518, Chemical Engineering.

BECHTEL

San Francisco

Bechtel Corporation offers immediate employment opportunities to chemical engineers experienced in process design of major petrochemical, refinery, or similar processing units.

Liberal transportation and relocation allowances for you and your family. Please send resume of experience, including present and required salary, to W. A. Anderson, Technical Recruiting.

Bechtel Corporation
220 Montgomery Street
San Francisco, Calif.

Editorial Position

Immediate opening on Chemical Engineering's editorial staff of 20 engineer-editors for another young engineer to solicit, evaluate, edit or write technical news stories or articles on process and engineering developments and trends in the chemical process industries. Unusual opportunity to broaden industry and professional contacts, education and experience. Requirements: Degree in chemical engineering or closely related field with experience in chemical process work; ability to evaluate chemical process and engineering information; able to write clearly, concisely and accurately; must like and work well with people; initiative and imagination. New York City location with opportunity for some out-of-town travel. Please send complete resume of education, experience, salary requirement and other pertinent information to:

Personnel Dept.
McGraw-Hill Publishing Co.
330 West 42nd Street
New York 36, New York

SENIOR CHEMICAL ENGINEER

Progressive medium-sized chemical manufacturing firm requires a seasoned chemical engineer. Person selected will be responsible for economic evaluations, process design, and plant construction for operations throughout the world.

If you are interested in a challenging job with a future, please submit resume, including personal requirements, outside interests, education, and experience, to M. B. Carus, Executive Vice President, Carus Chemical Company, Inc., Box 364, LaSalle, Illinois.

EMPLOYMENT PROBLEM?

When you are in need of specialized men for specialized jobs, contact them through an employment ad in this publication.

Equipment Searchlight

CE's Searchlight spots the big bargains in used, resale and rented equipment. Check this issue's listings—most complete in the field—for items you need now.

▶ **Coverage** — National. Equipment and facilities—used, resale and rental—for the process industries. For sale, wanted, for rent.

▶ **Rates**—$21.75 per inch for all ads except on a contract basis; contract rates on request. An advertising inch is measured ⅞ in. vertically on a column; 3 columns, 30 in. per page. Ads acceptable only in display style.

▶ **Closing date**—November 13th issue closes October 20th. Send all new ads to Chemical Engineering, Classified Adv. Division, P. O. Box 12, New York 36, N. Y.

HOW to LOCATE EQUIPMENT

without cost or obligation

This service is aimed at helping you to locate Surplus New or Used equipment, if you do not find your present requirements advertised in this section.

Send us the specifications of the equipment wanted and you will receive an immediate reply with full details.

EQUIPMENT FINDERS BUREAU
SS-6663, Chemical Engineering
Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

CIRCLE A ON READER SERVICE CARD

BEST VALUES

Vacuum Dryer: Stokes 2' x 6' Rotary, jacketed, St.St. T316. With drive, condenser, receiver.
Evaporators: three St.St. Buflovak dbl. eff. units 668-708-845 sq. ft. each.
Evaporator: Mojonnier dbl. eff. St.St. 1250 sq. ft.
Dryers: Double Drum, 42 x 90; 32 x 90 Buflovak.
Dryers: Double Drum, 42 x 120; 36 x 84 American.
Heat Exchangers: (2)-1900 sq. ft. admiralty tubes, steel bodies, ASME.
Twin Shell Blenders: P.K. 5 cu. ft. St.St.; P.K. 30 cu. ft. steel, with intensifier
Centrifuges: Tolhurst 40" and 26" Suspended, perf.
Centrifuges: Tolhurst 48" St. T316, Underslung, perf.
Filter, Rotary Vacuum with pressure housing, Dorr Oliver 5'3" dia. x 4' face (2).
Tanks: (2) 2300-1500 gal., vertical St.St.
Tanks: (2) 3000-1500-900 gal., vertical St.St. for vacuum with coils.
Kettles: (2) 600 gal. agitated St.St.; with 15 P.S.I. steel jacket.

BEST EQUIPMENT COMPANY
1737 W. HOWARD ST. CHICAGO 26, ILL.
AMbassador 2-1452.

CIRCLE B ON READER SERVICE CARD

BOILERS

HI-PRESSURE
turbogenerators, pumps, fans,
Nation's largest inventory, New & Used

INDECK POWER EQUIPMENT CO.
9750 Skokie Blvd., Chicago (Skokie) Ill. OR 3-7666

CIRCLE C ON READER SERVICE CARD

FOR SALE
WYSSMONT TURBO DRYERS

5—Rotating Tray type, Model No. VTL-24, Tray, with tray and fan drives. Includes externally mounted 4-coil Steam Heat Exchanger, and motorized Blower to heat air to Dryer. Further information and price on request.

DALTON SUPPLY CO.
2181 E. Huntingdon St. Phila., Pa.

CIRCLE D ON READER SERVICE CARD

"SEARCHLIGHT" IS Opportunity Advertising

—to help you get what you want—to help you sell what you no longer need.

Take Advantage Of It

For Every Business Want

"THINK SEARCHLIGHT FIRST"

SPECIALS
PUMPS & COLLOID MILLS

Stokes 212G Vac. Pumps 130 cfm.
Nash Vac. Pumps TS-10—108 cfm.
Shriver Diaphragm Pump 1½ H.P.
Shriver "0" Diaph. Pumps ¼ H.P.
Charlotte M20-ND T-316 SS Colloid Mill w/20 HP XP Motor—600 gph.
Eppenbach QV-6-2 Colloid Mill 15 gph.
Homogenizer 10 HP, S.S.—200 gph.
Ask for Bulletin A-46 just out, for complete listings.

THE MACHINERY & EQUIPMENT CO.
91-93 New Jersey R.R. Ave.,
Newark 5, N. J. Market 2-3103

CIRCLE F ON READER SERVICE CARD

ECH SPECIAL

J. H. Day #40 Imperial Jktd. Double Arm Mixer 300 gal. cap., 40 HP Exp. pf. mtr.
SOuth 8-4451—4452—8782

EQUIPMENT CLEARING HOUSE, INC.
111 33 Street Brooklyn 32, N. Y.

CIRCLE E ON READER SERVICE CARD

COMPRESSORS

No better values at any price

72 CFM 1500 PSI 6¼-3¾-1⅝x7 CP
80 CFM 3500 PSI 6¾-4-1 7/16x9 IR ES3
138 CFM 100 PSI 7x7, Ing. ES. CP & Joy
208 CFM 350 PSI 9-4x9 Ing. ES2
288 CFM 100 PSI 9x9 Ing. Worth. CP
311 CFM 1500 PSI 10½x7⅛-3⅛-13 IR-ES3
465 CFM 100 PSI 12x11-IR-ES CP.T. Worth HB
502 CFM 125 PSI 12x13 Worth HB
676 CFM 110 PSI 15-9¼x12 Ing. XRE 3-60-220
686 CFM 100 PSI 14x13 Ing. ES
880 CFM 125 PSI 18-11x10 Ch. Pn. v-ce 150 HP Syn 3-60-440/2300
1352 CFM 125 PSI 18½-11½x8½ Ing. XLE 200 HP Syn 3-60-4160
2200 CFM 100 PSI 26-15x28 Ch. Pn. oce 350-HP 3-6-4160-4600 & PF
1750 CFM 125 PSI 15½-10x10 Ch. Pn. wce 300 HP Syn. 3-60-2300

AMERICAN AIR COMPRESSOR CORP.
Chem. Road, North Bergen, N.J. UNion 5-1397

CIRCLE G ON READER SERVICE CARD

ECONOMIZE DOLLARWISE

NEW STAINLESS EVAPORATOR

Long tube 751-1" OD 12 ga tubes 15' long. Evaporation rate 17,000# water per hour at 235°F. Entire unit constructed of type 309 and 304 stainless steel.

SAVE MANY THOUSANDS

ME MACHINERY AND EQUIPMENT CO., INC.
123 Townsend St. · San Francisco 7, Calif.

CIRCLE H ON READER SERVICE CARD

NEW FILTER, stainless steel NIAGARA 48" dia. w/510 sq. ft.

NEW GRANULATOR #24, Stokes oscillating, S/S, also used 43A, S/S

NEW VOTATOR, S/S, lab. model, 4 speed FURNACE, electric, 5"X12"X30" muffle, 1600°C, Globar, w/50KVA transformer

MIKRO PULVERIZERS, 2 model 2TH w/ 10HP motors & vari-drive feeds

OVEN, Truck/Tray, 650° F. electric, 5'X6'6"X14', self-contained package unit.

LAWLER COMPANY
Durham Ave. Liberty 9-0245 Metuchen, N. J.

CIRCLE J ON READER SERVICE CARD

LOCOMOTIVES—RR CARS & CRANES
9 Gen. Elec. 20, 25, 45, 65, 70, 80, 100, 125 Ton
25-Ton Industrial Brownhoist 60' Boom Crane
200—50 Ton Box 300—70 Ton Gondola Cars
300—1½, 5, 20 & 30 yd Dump Cars
40-Ton Amer 60' Boom Diesel Loco Crane

PLANT EQUIPMENT
2—Wemco 2M-HMS Plants
No. 1 —Sturtevant Hammer Bar Mill
No. 2 Robins Vertical Cone Crusher
24" x 24" Jeffrey Single Roll Crusher
No. 1 Sturtevant Rotary Fine Reduction Crusher
F55 Syntron Grizzley Feeder
5' x 8' & 4½' x 9' KVS Air Swept Ball Type Mills
Ball Mills: No. 56, 5' x 5', 6' x 4', & 7' x 22'
Hardinge Mills: 3' x 8', 5' x 22" & 8' x 22"
5' x 22" Hardinge Air Sweep Ball Mill complete New 1951
Rod Mills: 4' x 11', 6' x 12' & 7' x 15'
Jaw Crushers: 9" x 24", 10" x 30", 13" x 24", 14" x 28", 18" x 36", 30" x 36", 66" x 84"
Crushers, Fine Reduction: 22", 2', 3', 4', 5½' x 7'
636 & 436 Allis Chalmers Hydrocone Crushers
Crushers Roll: 24" x 14", 30" x 14", 40" x 16"
Rotary Dryers: 5' x 30', 6' x 50', 6' x 70' & 8' x 80'
Rotary Kilns: 6' x 70', 7' x 110' & 9' x 160'
2—13" x 120" Buflovak Atmos Double Drum Dryer
Roto Louvre #207-10 Type 316 S. S. Link Belt
150—1½, 2 & 4 yd & 30 yd Dump Cars
5 & 10 HP LB Car Pullers
16 Gayco Centrifugal Air Separators
BX-100 Sutton Steele & Steele Air Table NEW
6—30" x 32" Dings Magnetic Head Pulleys
690', 2200', 3068' & 3600-7500' IR. Compressors
4100 CFM Sly Dust Collector

WANT BUY DRYERS—KILNS—CRUSHERS
R. C. Stanhope, Inc., 60 E. 42 St., N.Y. 17, N.Y.
Tel. MU 2-3075 or MU 2-1898

CIRCLE K ON READER SERVICE CARD

Pfaudler 10 gal. Glass Lined Kettle
Hersey 5'x26' Rotary S.S. Dryer
Buffalo 32"x90" Double Drum Dryer
Day Hy-R Speed Mill 20 HP XP
SEND FOR LISTINGS

STEIN EQUIPMENT CO.
107—8th Street Sterling 8-1944 Brooklyn 15, N. Y.

CIRCLE L ON READER SERVICE CARD

IT'S GOT TO GO . . . BEFORE IT SNOWS!

LIQUIDATING TWO CHEMICAL PLANTS
NIAGARA FALLS, N. Y. and EVERETT, MASS.

COLUMNS

78″x18′x¼″—316 Stainless Steel, 14 trays 180 bubble caps per tray, 50 PSI.
72″x30′x⅛″—347 Stainless Steel, 21 trays 38 bubble caps per tray.
48″x41′x5/16″—316 Stainless Steel, 40 trays, 70 bubble caps per tray, 100 PSI design.
36″x20′x3/16″ packed 316 Stainless Steel, 100 PSI.
14″x17′6″x⅛″ packed 316 Stainless Steel.
12″x18′8″x3/16″ packed 347 Stainless Steel, 100 PSI.
Pfaudler 20″x27′, **16″x21′, 16″x10′** glass lined.

REACTORS

Pfaudler 500 gal. and 300 gal. glass lined, jacketed, agitated, 75 PSI.
Dopp 1700 and 1000 gal. Ni-resist, jacketed, Type "J" agitator, 150 PSI.
Patterson 500 gal. Steel, jacketed, agitated, 50 PSI.
Alloy Tank 750 gal. Type 316 Stainless Steel, 42 PSI.
Alloy Tank 300 gal. Type 316 Stainless Steel, 42 PSI.

COMPRESSORS—VACUUM PUMPS

Clark 9920 CFM 149PSIA Suction, 239PSIA Disch.
Allis-Chalmers Centrif. 7500CFM @ 42.5PSI; 1250 HP.
Worthington YO 1360 CFM @ 35 PSI; 150 HP.
Worthington 1015 CFM @ 35 PSI Steam Driven.
Norwalk Hydrogen Compressor 5 CFM @15000 PSI.
Nash L3 Stainless Compressor 127 CFM @ 20 PSI.
Nash CD 663 Stainless Compressor 50 CFM @ 75 PSI.
Nash #4 and TS10 Vacuum Pumps.
Stokes 612F Microvac 500 CFM Vacuum Pump.

CENTRIFUGES—FILTERS

Sharples C-27 Stainless Super-D-Hydrator.
Fletcher 40″ Suspended Perforated basket 15/7½ HP.
Rochester 30″ Stainless Suspended imperforate basket.
Sharples #6 Super Centrifuge, Stainless bowl.
Oliver 5′3″x3′ Stainless Precoat Rotary Vacuum Filter.
Goslin 36″x24″ Stainless Rotary Vacuum Filter.

KILNS—DRYERS

Allis-Chalmers 8′x60′x⅝″ shell, Rotary Kiln, Falk reducer and motor.
Link Belt 7′x45′x½″ shell Rotary Kiln.
Vulcan 6′x124′x¾″ Rotary Kiln, reducer and motor.
Link Belt 604-24 Stainless Steel Roto-Louvre Dryer.
Rotary Dryer 4′x40′x⅜″, reducer, motor, new shell.
Buflovak 6″x8″ vacuum double drum Dryer.
Blaw-Knox 6′x5′6″ vacuum single drum Dryer.
F. J. Stokes Model 38A Steam heated Dryer, 16 trays.

STAINLESS STEEL TANKS

108,000 gal. closed 316 Stainless 18′x61′x¼″.
17,500 gal. closed 316 Stainless 15′x16′x⅜″.
11,500 gal. closed 316 Stainless 12′x15′x3/16″ Agit.
10,500 gal. closed 316 Stainless 10′x23′x3/16″.
4,500 gal. closed 347 Stainless, heated, 6′x25′x¼″.
4,000 bal. closed 304 Stainless, heated 8′x12′x3/16″.
3,500 gal. closed 304 Stainless, 8′x9′x5/16″.
1,200 gal. closed 347 Stainless clad 5′x8′x¼″ Agit.
750 gal. closed 347 Stainless 5′x5′x3/16″ agitated.
500 gal. closed 316 Stainless 4′x5′x3/16″.
(20) 400 to 50 gal. Type 316 and 347 Stainless Tanks.
14—Aluminum Tanks 12,000, 10,000 and 7,000 gal.
2500 gal. Pfaudler closed, glass lined, 78″x9′.

HEAT EXCHANGERS—CONDENSERS

2300 sq.ft. 564— 1″x16′ Type 316 Stainless tubes.
1000 sq.ft. 370—¾″x14′ Type 304 Stainless tubes.
800 sq.ft. 375—⅝″x14′ Type 316 Stainless tubes.
615 sq.ft. 375—⅝″x10′ Type 316 Stainless tubes.
420 sq.ft. 268—¾″x 8′ Type 304 Stainless tubes.
306 sq.ft. 130—¾″x12′ Type 316 Stainless tubes.
225 sq.ft. 96—¾″x12′ Type 316 Stainless tubes.
188 sq.ft. 96—⅝″x12′ Type 316 Stainless tubes.
146 sq.ft. 91—⅝″x8′6″ Type 316 Stainless tubes.
68 sq.ft. 22—¾″x16′ Type 347 Stainless tubes.
1860 sq.ft. *Reboiler* 271—1″x12′ Stainless tubes.
618 sq.ft. Stainless Brown *Fintube* in 77 sq.ft. units.
Pfaudler 2″, 3″, 4″ Glassed Lined *Double Pipe Coolers.*
5000 to 50 sq.ft. Admiralty and Steel Tube Condensers.

MISCELLANEOUS STOCK ITEMS

Swenson 435 sq.ft. Stainless Single Effect Evaporator.
Baker Perkins Stainless 300 gal. sigma blade Mixer.
Stokes RDS3 and DDS2 Rotary Tablet Presses.
Stokes #243E Oscillating Granulator 5 HP.
Symons 5½′ short head heavy duty Cone Crusher.
Raymond #50 and #51 Imp Mills
Squire 40″x30″ Pan Dryer, jacketed.
Buflovak jacketed 6′ Vacuum Crystallizer with plows.
Rotex single deck Sifters 60″x84″; 30″x96″.
Sweco 48″ Triple Deck Sifter, Model A9062.
Swenson 24″x20′ Stainless Crystallizers, jacketed.
Triplex Pumps 2¼x4″ 316 SS liquid end 2000 PSI.
Anders Air Dehydrator Model 8FA Automatic.
Kemp Absorptive Dryer, Model FEO2-S Dual.
Centrifugal Pumps—Stainless—1″ to 3″, 10 to 750 GPM @ 35 to 100′ head.
Fork Lift Trucks 2000 & 6000 lb., gas engine driven.
3000 ft. 24, 30 & 36″ Rubber Troughing Belt Conveyor.
LARGE QUANTITY STAINLESS PIPE & VALVES.

Representatives on premises—Write for detailed catalogs

Heat and Power Co., inc.

60 E. 42nd STREET, NEW YORK 17, N. Y. MU 7-5280
310 THOMPSON BLDG., TULSA 3, OKLA. LU 3-4890

LIQUIDATIONS

CLEVELAND, OHIO

1—Raymond #73612 Super High Side 6-Roll Mill, with whizzer, cyclone, piping and motors.

1—Raymond # 6669 Super High Side 6-Roll Mill, with whizzer, cyclone, piping and motors.

1—Raymond #5047 High Side 4-Roll Mill, with whizzer, cyclone and piping

1—#1 Raymond Impact Mill, with whizzer, cyclone and piping.

1—Kilby Nickel Single Effect Force Feed Evaporators, 1200 sq. ft.
2—Oliver 5'3"x4' Nickel Clad Rotary Vacuum Filters.
2—Pfaudler 300 and 200 gal. Glass Lined Jkt. Agt. Reactors.
1—Sperry 30" C.I. Filter Press, 27 chambers.
1—Buflovak 32"x90" Dble Drum Dryer.
4—Feinc 8'x12' Rotary Vacuum Steel Filters, string discharge.
2—6'6" dia. x 60' Rotary Dryers.
1—5½'x4½'x50' Rotary Dryer.
7—Dorr 80' and 40' thickeners.
3—Vogt 387 sq. ft. Rotary Press. Filters.
2—Chicago Pneumatic 26"x14" Vacuum Pumps with 150 HP motors.
2—Fuller Kinyon Pumps H6.
1—Link-Belt 24"x90' Belt Conveyor
5—Nickel Centrif. Pumps, 2", 3".

KANSAS

1—8650 sq. ft. Forced Circulation Double Effect Evaporator, nickel clad bodies, nickel tubes, condenser, etc., UNUSED.
1—Louisville 4½' x 40' Rotary Steam Tube Dryer, 316 SS construction.
5—Glascote 500 gal. glass lined, Jacketed Reactors.
5—Pfaudler 26 sq. ft. glass lined Condensers.
1—Bird Young 18" x 24" rubber covered Rotary Vacuum Filter with Hastelloy "C" valve.
3—Lightnin Model 322-TEQ Drives, with rubber covered turbine agitators.

BRILL FOR VALUES

CENTRIFUGES

3—Bird 18" x 28", 24" x 38" Solid Bowl Continuous 304 S.S.
1—Bird 40" x 60" Solid Bowl Continuous 316 S.S. UNUSED.
5—Sharples C-20 and C-27 Super-D-Hydrator 316 S.S.
3—Sharples PY 14, PN14 Super-D-Canters 316 S.S.
2—Sharples #16, 304 S.S., 3 HP motor.
1—Tolhurst 40" 347 S.S. imperforate basket 15 HP UNUSED.

TANKS

25—500 to 3500 gal. Vertical 304 S.S. Tanks opened and closed, some agitated.
6—7500, 6000 and 2000 gal. Rubber Lined Tanks.
1—1500 gal. Stainless Pressure Tank, 5' x 10', 90#.
1—2000 gal. Horizontal 304 S.S. Tank 5' x 12'.
1—2500 gal. Vertical 304 S.S. Tank 8' x 7'.
1—10,000 gal. Rubber Lined Tank 10' x 17'6".
1—5500 gal. 316 S.S. Clad Pressure Tank 250 PSI.
2—3,000 gal. Aluminum Tanks, 7' x 11'
5—25,000 gal. Aluminum Storage Tanks.

REACTORS—EVAPS—CONDS—COLUMNS

1—Pfaudler 125 gal. 304 S.S. Jkt. Agit. Reactor, 150# int., 125# jacket.
2—Pfaudler 50 gal. glass lined, Jacketed, Agitated Reactors.
1—650 gal. 304 S.S. Reactor with 100 sq. ft. Bayonet Heater.
1—O. G. Kelly 3000 sq. ft. 309 S.S. force feed Evaporator UNUSED.
1—550 sq. ft. Buflovak monel single effect Evaporator.
1—300 sq. ft. Swenson 347 SS Single Effect Evaporator.
1—250 sq. ft. Buflovak 304 S.S. Single Effect Evaporator.
10—Stainless Heat Exchangers; 910, 536, 370, 250, 131, 70 sq. ft.
1—4'6" x 46' 316 S.S. Clad Column, 250 PSI.
8—3' x 20', 30" x 19' 347 SS Packed Columns.
1—24" x 35' 304 S.S. Bubble Cap Column.

FILTERS

1—Niagara 110 sq. ft. Vert. 316 S.S.
1—Niagara 92 sq. ft. Vert. Jkt. 316 S.S.
2—#10 Sweetland, 27 leaves 4" centers
1—#5 Sweetland 304 S.S., 120 sq. ft.
1—Oliver 6' dia. Horizontal 316 S.S.
1—Oliver 4' dia. Monel Horizontal.
1—U.S. 200 sq. ft. 304 S.S. Auto-Jet.
1—Hercules 400 sq. ft. 304 S.S. Pressure.
3—Oliver Precoat 5' x 6', 5' x 10', 8' x 10'.
1—Oliver 5'3" x 8' Steel Rotary Vac housing.
1—Feinc 3' x 1' 316 S.S. Rotary Vac.

DRYERS

1—Buflovak Vacuum Shelf, 17—60" x 80" shelves.
2—Buflovak 42" x 120", atmospheric double drum complete.
1—Buflovak 32" x 90" Atmos. Twin Drum.
2—Devine 4' x 9' single drum, atmospheric.
1—Buflovak 3' x 10' Rotary Vacuum.
6—Louisville Rotary Steam Tube, 6' x 30', 6' x 50'.
2—Louisville 8' x 50' Stainless Steel lined Rotary.
3—Rotary Dryers 6' x 50', 7' x 80", 8' x 80'.
1—Louisville 4½' x 25' Inconel Rotary.
1—Link Belt 6'4" x 24' Roto Louvre 316 S.S.
1—Atmos. Tray, 13 shelves, 3' x 3'.
2—10' and 4' dia. 304 S.S. Spray Dryers.
2—Wyssmont, 304 S.S. 6'2" and 9'6' dia.

MIXERS

1—Sturtevant 75 cu. ft. 304 S.S. Rotary Batch Blender 20 HP.
1—Abbe 110 gal. 304 S.S. Jacketed Agitated Vacuum Dispersall Mixer.
2—Baker Perkins 150 and 100 gal. jacketed double arm Sigma blades.
1—Baker Perkins 50 gal. jacketed.
5—Day "Cincinnatus" double arm, 250 and 100 gal.
2—Steel jacketed Powder Mixers, 225 and 350 cu. ft.
2—40 and 50 cu. ft. Powder Mixers 304 SS
2—Day 120 cu. ft. Jumbo Powder Mixers 25 HP motors.
1—45" dia. Lancaster Mixer 7½ HP motor.

MISCELLANEOUS

3—Kinney Vacuum Pumps, 1000 cfm, 10 microns, 15 HP.
3—Hardinge 6' x 36", 5' x 22" steel lined conical Ball Mills.
1—Sturtevant 6' dia. Air Separator 10 HP.
1—Komarek Greaves Briquetting Press 3½" face rolls.
3—Mikro Pulverizers, 1SH, 1SI and Bantam.
3—Swenson Walker Continuous Crystallizers, 24" x 30' sections.
2—Tyler Hummer 3' x 10' Double Deck Screens.
5—Day Roball Sifters, 40" x 120", 40" x 84", Double Deck.
6—Nash H6, H5, L5 Vacuum Pumps.
3—Nash H6, L3 347 SS Vacuum Pumps.
2—Stokes Rotary Tablet Machines DD2-DDS2.

Partial List of Values—Send for Complete Circular

BRILL EQUIPMENT COMPANY

35-61 JABEZ ST., NEWARK 5, N. J. Tel: MArket 3-7420—N. Y. Tel: RE 2-0820
TEXAS OFFICE: 4101 San Jacinto St., Houston 4, Texas—Tel: JAckson 6-1351

CIRCLE N ON READER SERVICE CARD

LIQUIDATION

COMPLETE CHEMICAL PLANT

Formerly Owned By The TOMS-RIVER CINCINNATI CHEMICAL COMPANY

REACTORS and PRESSURE VESSELS

9—Pfaudler and Glasscote 500 gal. Jacketed and Agitated Reactors.

5—Steel Jacketed and Agitated 500 gal. Reactors.

10—Lead Lined Sulphonators in various sizes from 500 gal. up.

1—6500 gal. Welded Steel ASME Brick and Lead Lined Pressure Vessel with Agitator.

1—Lead and Brick Lined 1000 gal.

2—Lead Lined Jacketed HI Internal Pressure, Agitated Reaction Kettle.

1—1200 gal. Rubber Lined with HAVEG Gate Type Agitator.

Cast Steel and Welded Steel Jacketed and Agitated NITRATORS, Autoclaves, Stills and Blow Cases.

CONDENSERS - RECEIVERS

28—Vertical Condensers and Receivers manifolded together.

4—Horizontal Condensers Receivers.

REFRIGERATION EQUIPMENT

2 Vilter 9½" x 9½" Ammonia Compressors with 100 HP motors.

2—YORK Cubice Machines with accessories.

1—VOGT Tube Ice Machines & Accessories.

1—Large Steel Hopper with Agitator 22' x 29' for receiving ice cubes.

LOCATION
NORWOOD, Cincinnati

FOR SALE or LEASE

In it's entirety or separately

- A SCORE OF MODERN BUILDINGS
- 365,000 Sq. Ft. Floor Space
- 7½ ACRES Served by 2 Railroads
- Equipment Ready to Operate

INSPECTION on the PREMISES

SEND FOR BROCHURE with COMPLETE LISTINGS

For Arrangements and Price Quotations Wire or Phone
STerling 8-4672

FILTER PRESSES

SHRIVER Plate and Frame Presses in Cast Iron, Wood, Ni-Resist, etc. Many with HYDRAULIC Closing Devices.
(4) 24" x 24" (50) 30" x 30"
(34) 36" x 36"
Dozens of Skeletons . . . All Sizes, Types.
69—J. H. Day Round Recessed Plate Open Delivery Presses, 18".

MILLS

Unlined Steel Ball Mills:
(2) 3' x 5' (14) 5' x 7'
(1) 4' x 6' (5) 5'3" x 7'3"
(1) 4'6" x 5'6" (1) 6' x 8'

ROD MILLS

(4) 6'4" x 6'4" (2) 5' x 4'6"

ROTARY BLENDERS

(2) 6' x 7'6"

DRYERS

19—Buffalo Model J Vacuum Chamber Dryers, 60" x 80" with 20 shelves.
8—Atmospheric Truck Dryers with Multi Compartments & Accessories.

PULVERIZERS

5—MIKRO Pulverizers Model #2 S 1.
2—Klus Fine Grind Pulverizers.
5—Raymond Model "OO" Screen Mills.
1—Raymond Whizzer Classifier.

CHOICE EQUIPMENT FROM OUR NEW YORK STOCK

MILLS—GRINDERS PULVERIZERS

Mikro Pulverizers up to No. 4; Mikro S/S Atomers No. 5 and No. 6.

Fitzpatrick Comminutating Machines, in Stainless; Models M, D and K.

Abbe Jacketed Steel Ball Mill; 42"x32"; with charge of balls.

Jay Bee Model T Hammer Mill; 36 Hammers; 12"x15½" Feed.

Szegvari Stainless Lab Jacketed Attritor Type SU.

Abbe No. 3 Buhrstone Lined Pebble Mill; 52"x36".

Colton Stainless Steel Rotary Granulator No. 540-15 with Stainless Sifter.

Colton Stainless Granulator (same as above; no Sifter).

Kent 3 Roll Lab Mill 4"x8" with Motor and Starter.

Mitts Merrill Hogs; 15 CRC 14" x20"—40 HP and 12 CRB 12"x15"—30 HP Motor.

Gruendler No. 1 Crusher 15—¾x16"; 20 HP.

Universal Jaw Crusher 8"x10" with Extra Jaws.

MIXERS FOR EVERY PURPOSE

Brand NEW FALCON Ribbon Blenders; all sizes now in Stock; S.S. or Mild Steel.

Baker Perkins Heavy Duty Jacketed Mixers; from 5 gal. to 300 gal.

J. H. Day Mogul Mixer, 150 gal. Vac. Cover; 75 HP.

Day Cincinnatus Double ARM Jacketed Mixers, 75, 200, 300 gal.

Must Move Immediately Cement Mill Machinery
from Tennessee Location

Allis Chalmers equipment for entire raw and finishing departments. Capacity 4000 Barrels per day. Mills and Separators may be purchased separately.

Two 7' x 22' Mills (two compartment)
Three 7' x 22' Mills (single Compartment)

Each of these Mills have Meehanite Liners and are directly coupled to 400 HP Motors, operated in closed circuit with Three 14' Raymond DOUBLE WHIZZER Mechanical Air Separators NEW in 1950, each V Belted to 75 H.P. Motor: Also Bucket Elevators, Conveyors etc.

REACTORS and PRESSURE VESSELS

Struthers Wells 2000 gal. Stainless Reactors; Jktd. and Agtd.

2 Stainless 400 gal. Reactors Jktd. & Agtd. by Struthers Wells.

6 Dorr-Oliver 550 gal. Stainless Thickeners or Reactors.

Pfaudler Glass Lined Reactors, Jacketed, Agitated from 50 gal. to 500 gal.

CENTRIFUGES—CLARIFIERS

Stainless Suspended Type Centrifugals from 30" to 60".

2 Sharples Stainless Steel Model PN14 Super-D-Canters.

Sharples C27 Super-D-Hydrator in Type 316 Stainless; 40 HP.

2 Bird Continuous Horizontal Centrifuges; S/S & Monel 24".

2 Bird Rubber Covered Fume-Tight 48"; with Plows; 40 HP.

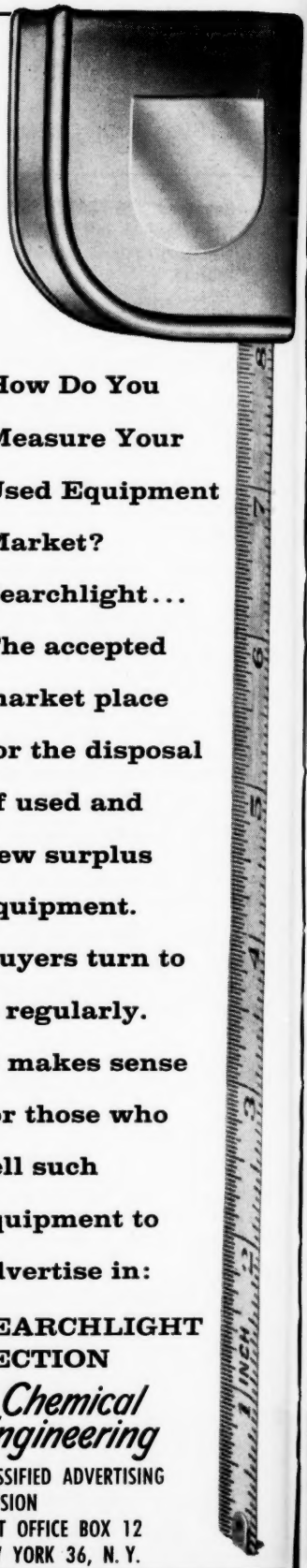
FIRST MACHINERY CORP.

209-289 TENTH STREET, BROOKLYN 15, N. Y.

PARKING ON THE PREMISES

PHONE: STerling 8-4672

CIRCLE M ON READER SERVICE CARD



How Do You Measure Your Used Equipment Market?

Searchlight... The accepted market place for the disposal of used and new surplus equipment.

Buyers turn to it regularly. It makes sense for those who sell such equipment to advertise in:

SEARCHLIGHT SECTION

Chemical Engineering

CLASSIFIED ADVERTISING DIVISION
POST OFFICE BOX 12
NEW YORK 36, N. Y.

LIQUIDATIONS—

LITTLE ROCK, ARK.
ORANGE, TEXAS
OMAHA, NEBRASKA

KETTLES — REACTORS

1—2000 gal. Glascote blue G/L reactor, ASME 50 psi or vac. int., 90 psi jkt.
64—1400 gal. Pfaudler blue G/L jkt. kettles, Agit., baffles.
3—1350 gal. T347 SS kettles, open top.
14—1250 gal. Pfaudler blue G/L jkt. reactors, Agit.
1—1000 gal., T316 SS jacketed reactor, ASME, UNUSED.
1—1000 gal. Dopp cast iron kettle, 125# jacket, 15# int., Agit.
1—750 gal. Graver T304 SS jkt. fermenter, ASME 30# int., 30# jkt., 10 HP Turbine Agit.
2—600 gal. T304 SS reactors, jkt., Agit.
50—600 gal. Pfaudler Stainless jacketed kettles, open.
2—500 gal. T304 SS reactors, jacketed, ASME, Vacuum—Unused.
6—465 gal. T304L SS reactors, jacketed, 150# int., 175# jkt.
1—300 gal. T304 SS jacketed reactor, vac. ASME—UNUSED.
1—300 gal. Pfaudler blue G/L reactor, Agit., Jkt., ASME.
1—200 gal. T304 SS jkt. reactor.

MIXERS—MILLS

40—Baker-Perkins #17, 200 gal. sigma-blade, jkt. mixers.
1—Baker Perkins #15, 100 gal. Disp., T347 SS 25 HP drive.
1—Baker-Perkins #15-UUMM, 100 gal. Disp. blade, ASME jkt., 100 HP, Comp. Cover, motorized tilt.
1—J. H. Day #6, 100 gal., St. St. sigma.
2—J. H. Day #5, 75 gal., sigma.
1—Sturtevant 75 cu. ft. T304 SS blender.
2—145 cu. ft. ribbon mixers.
1—Raymond 50", 5-roller hi-side, mill.
1—Raymond 66", 6-roll hi-side mill.
13—Abbe 6' x 8' batch pebble mills.
1—Hardinge 8' x 48" conical pebble.
2—Hardinge 7' x 36" conical mills.
1—Allis 6' x 12' rod mill.
1—Gemco 60 cu. ft. T304 SS conical blender.
1—Bonnot 5' x 10' ball mill, 75 HP.
3—Fitz. SS mills; D, K, F.
1—Mikro #2TH pulverizer.
2—Symons 2' cone crushers.

Send for Detailed and Illustrated Circulars

STAINLESS STEEL TANKS
(T304 UNLESS NOTED)

3—20,000 gal., 14' x 15', T316LC, cone bottom, 3/8".
2—13,000 gal. 11'-10" x 15'7".
2—12,000 gal., 11'-16" x 15'-6".
1—11,000 gal., 9'-6" x 20', dished, UNUSED.
5—3650 gal., 10' x 7', vert., open.
1—3350 gal., 8'x8'-6", agit., 50 psi.
1—3300 gal. 6' x 14'6", vert.
1—3250 gal., 6' x 15', T316.
3—3000 gal., 5' x 19', T347, ASME 60 psi.
2—2600 gal., 7' x 8', T316, dished.
1—2250 gal., 8' x 6', T316.
5—2100 gal., 8' x 5'6", dished.
1—2100 gal., 6' x 9', T316, cone.
12—1750 gal., hoppers, 4'-5" x 7'-4" x 9'-2".
4—1350 gal., 4' x 14', T347, dished, ASME 60 psi coils.
5—1350 gal., 7' x 4'-6", T321.
1—1300 gal., 6' x 6', 3/8", dished.
3—1100 gal., 4' x 11', T347, ASME 60 psi.
3—1000 gal., 4'-6" x 8'-6", dished.
3—850 gal., 4' x 9', 3/8", dished.
1—800 gal., 5'x5'6", 1/4", dished.
3—750 gal., 5' x 5', 3/16", dished.
6—685 gal., 3' x 13', T316, coils.
3—300 gal., 4' x 3', T347, ASME 60 psi.

PARTIAL LIST
SEND FOR COMPLETE LIST!

DRYERS — KILNS

2—Buflovak 42" x 120" double drum dryers, ASME 160# WP.
1—American 42" x 120" dbl. drum.
1—Buflovak 42" x 90" dbl. drum.
2—American 36" x 84" dbl. drum.
1—Buflovak 32" x 52" dbl. drum.
1—American 36" x 84" double drum dryer, ASME, VACUUM.
1—Buflovak 5' x 12', single drum dryer, Vacuum, UNUSED.
1—Buflovak 6" x 8" dbl. drum.
5—F. J. Stokes #138J-16, 195 sq. ft. vac. shelf dryers.
1—Vulcan 10' x 11' x 175' rotary kiln.
2—B. & Snow 8'-6" x 70' rotary dryers, 5/8" welded shell, late model.
1—Davenport 8' x 60' rotary, 7/16".
1—7'-6" x 62" rotary kiln, 1/2".
1—6' x 150' rotary kiln, 5/8" welded, w/burners, etc.
1—Louisville 5' x 30' steam-tube.
2—Louisville 4'-6" x 25' rotary steam-tube dryers, welded.
1—Bartlett & Snow 3' x 15' rotary dryer, Everdur metal shell.
1—3' x 23' rotary, 1/4" welded.

EVAP. — STILLS COLUMNS — EXCHANGERS — BOILERS

7—4050 sq. ft. calandria type evap., copper tubes, cast iron shell.
1—1250 sq. ft. Mojonnier dbl.-effect Stainless Sanitary evaporator.
4—Buflovak double-effect stainless evap. vert. long-tube type: 1025, 840, 710, 588 sq. ft.
1—630 sq. ft Struthers-Wells T316 SS Calandria evap.
1—320 sq. ft. steel reboiler.
1—250 sq. ft. Buflovak T304 SS, single effect recompression evap.
1—118 sq. ft. Stokes T316 SS still.
1—36" dia. x 6 plate T316 SS column.
2—Vulcan T316 SS 10 plate bubble cap columns: 110", 60" dia.
6—30" x 19' T347 SS packed columns.
8—24" x 16' Duriron packed columns.
1—24" x 33' Duriron & SS column.
1—1960 sq. ft. T316 SS exchanger remov. bundle, ASME 75# WP.
1—1450 sq. ft. T316 SS condenser.
5—1400 sq. ft. T316 SS gas converters.
1—900 sq. ft. T304 SS exchanger.
3—800 sq. ft. T316 SS condensers.
1—730 sq. ft. T316 SS exchanger.
6—691 sq. ft. copper dbl. pipe cooler.
1—510 sq. ft. T316 SS condenser.
8—400 sq. ft. T304 SS pipe coolers.
12—Amer. Heat Reclaiming T316L SS spiral exchangers: 162, 73 sq. ft.
15—75 sq. ft. nickel pipe coolers.
30—T316 SS heat exchangers & condensers: 425, 410, 400, 290, 277, 200, 186, 165, 150, 142, 105, 83, 73, 54, 50, 30 sq. ft.
50—Duriron exchangers & condensers: 10-170 sq. ft.
3—Waste-heat boilers, 250 psi.
5—Comb. Eng. 435 HP water-tube boilers, 300 psi.

LITTLE ROCK, ARK.

STAINLESS PUMPS

Worthington Worthite Cent. Pumps; 4" x 3", 3" x 2", 2" x 1½", 1½" x 1", w/motors.
LaBour 2" 316 SS self-priming cent. pumps w/motors.
Aurora 1½" SS sump pumps

PERRY EQUIPMENT CORPORATION

1413-21 N. SIXTH ST. PHILADELPHIA 22, PA.

Phone POplar 3-3505

CHEMICAL & PROCESS MACHINERY PERRY EQUIPMENT INDUSTRIES

CIRCLE P ON READER SERVICE CARD

FOR "IMPOSSIBLE" BUDGETS

PROFIT SAVERS

14—Rotary Flame Dryers, 6' x 35', 6' x 50', 6' x 60', 8' x 40' and 8' x 60'. In our stock

4—Rotary Kilns, 1-11'6" x 203' 3-10'6" x 203'. Each complete

2—Vredenberg Valve Bag Packers. 1-3 spout Mod 107 FC, 1-single spout mdl 116 FDS

6—Beach Russ Model 100-D Vac Pumps. 5 HP. 100 CFM @10 microns

3—Komarek-Greaves Mdl 21-94 Briquet Presses. 75 HP mtrs. 21¼" dia. x 9¼" face.

1—Buflovak 42" x 90" Mdl D-3 Dbl drum Dryer. 15 HP gear mtr. SS trim. Complete

2—Lee 125 gal SS steam jcktd Kettles. 90# press, SS vlvs

1—Oliver 3' x 6' rubber rotary cont. Vac Precoat Filter. Variable speed drive

For immediate quote, write or phone collect—GA 1-1380

MACHINERY AND EQUIPMENT COMPANY
123 Townsend St. · San Francisco 7, California

CIRCLE Q ON READER SERVICE CARD

MODERN REBUILT MACHINERY

UNION Rebuilt Machinery Established 1912

Baker Perkins, Day, W. & P. Heavy Duty Mixers, 5 to 150 gal. caps.

J. H. Day Dry Powder Mixers, 50 to 1000 lbs.

Mikro No. 6 S. S. Atomizer and Bantam, 1SH, 2TH, 3TH and 4TH Pulverizers.

Raymond Models "0" and "00" Pulverizers.

Rotex, Day Sifters, 20 x 48, 40 x 84, 40 x 120.

Colton Model 241 Double Rotary Tablet Press.

Groen 150 gal. Stainless Steel Double Arm Steam Jacketed Mixing Kettles.

Stokes & Smith Models G1, G2, HG84, HG87 and HG88 Fillers.

Fletcher 30" Stainless Steel Basket Centrifuge.

WRAPPERS: Package Machinery, Hayssen, Hudson Sharp, Battle Creek, Scandia, Wrap-King, all sizes and models.

Pneumatic Scale High Speed Automatic Cartoning Line with Feeder, Bottom Sealer, Top Sealer, Wax Liner, Interconnecting Conveyors.

Complete Details and Quotations On Request

UNION STANDARD EQUIPMENT CO.

318-322 Lafayette St. New York 12, N. Y. CAnal 6-5333

167 No. May St. Chicago 7, Illinois SEely 3-7845

CIRCLE R ON READER SERVICE CARD

SPECIALS

Kettles: 275 gal. type 316 st. steel, agitated.
Mill: Day Hispeed Model B 14x30" 3-Roll.
Column: 24" x 22' 316 stain. steel.
Pebble Mills: Abbe #3, #6, and others.
Dryer: American 24x48" dbl. drum.
Dryer: Bowen lab. spray, st. st.
Evaporator: Buflovak sgl. eff, st. st. 94 sq. ft.
Dryer: Porter 2 x 4' vac. drum., st. st.
Centrifugal: Tolhurst 26" rubber 2-speed.
Filter: Sweetland #5 st. st. lined.
Filter: Oliver precoat 12x2" type 316 st. st.
Vacuum Pans: 42" and 72" stain. steel.
Dryer: Proctor & Schwartz 6-tray st. st.
Powder Mixers: Day Jumbo 120 cu. ft.

Write us or call Seeley 8-1431
Send us a list of your idle machines

LOEB EQUIPMENT SUPPLY CO.
820 W. Superior St., Chicago 22, Ill.

CIRCLE T ON READER SERVICE CARD

Dowtherm 225 KW
Autoclave S.S.—50 gal—2000 lb. pres.
Autoclave S.S.—3½ gal—2000 lb. pres.
Proctor & Schwartz finned drum drier
Centrifuge S.S. 26"—Tolhurst
2 Evaporating Dishes—jacketed S.S. 71" dia.
1 Kettle S.S.—jacketed—500 gal.
2 Kettles S.S. Jacketed—agitated—250 gal.

MACHINECRAFT CORPORATION
800 Wilson Ave. (East of Doremus)
Newark 5, N. J. MI 2-7634

CIRCLE U ON READER SERVICE CARD

LIQUIDATION VALUES

From the Former
Wilson and Company Refinery
Chattanooga, Tennessee

EXPLOSION-PROOF ELECTRICAL EQUIPMENT

100—Rowan Disconnect Switches, 30 amp —600 amp, 3-pole, oil immersed, single throw, fused, 250 volts—600 volts, $100.00 and under.

150—Rowan Across-The-Line AC oil immersed, motor controlled, Combination starters, 7½ hp.—25 hp., 440 volts, $75.00 and under.

16—Kinney High Vacuum Pumps, Model KDH-130, 131 cfm., $450.00 each.

SMC INDUSTRIES, INC.
Hooker Road • Chattanooga 10, Tenn

CIRCLE S ON READER SERVICE CARD

IT COT LE$$ at M&E

RAYMOND HI SIDE MILL

Model 5048 or 5058. New spider, journals, rollers, plows. Has fan, whizzer air separator, stocking collector, four motors. New 1951, latest model. Priced to sell.

Immediately Available From Our Stock

MACHINERY AND EQUIPMENT CO., INC.
123 Townsend St. · San Francisco 7, Calif.

CIRCLE W ON READER SERVICE CARD

Buying
Good USED Equipment
is frequently the difference between having needed equipment or doing without it.

Mr. Used Equipment Dealer:

When you advertise in the Searchlight Section . . . You have hired your most persuasive salesman:

He's efficient . . . He thrives on long hours . . . His territory is the entire nation . . . and overseas . . . He doesn't see buyers of used and new surplus equipment: They see him—regularly. They depend on him.

He is Searchlight—The section of this publication where wise dealers advertise and list their stocks for sale.

SEARCHLIGHT SECTION

Classified Advertising Div.
Post Office Box 12
New York 36, N. Y.

GET READY—GET SET
for production profits with
GELB
CHEMICAL PROCESS EQUIPMENT

1—Sparkler Hastelloy "B" Model 18D12 jacketed filter.
1—Sparkler stainless steel Model 33D7 jacketed filter.
1—Dover Type 316 4000 gal. jacketed reactor.
1—Alloy Fabricators Type 316 stainless steel 4000 gal. reactor.

AUTOCLAVES, KETTLES, REACTORS

1—Pfaudler Series R 1500 gal. glass lined jacketed reactor, complete with impeller type agitator, baffle and drive.
1—Glascote Series HR 1000 gal. glass lined jacketed reactor, complete with impeller type agitator, baffle and drive.
1—Pfaudler 750 gal. glass lined jacketed reactor.
2—Pfaudler Series EM 300 gal. glass lined jacketed reactors.
4—Pfaudler Series P glass lined jacketed reactors, complete with agitators and drives, 5, 20 and 30 gal.
1—Glascote 750 gal. glass lined jacketed vacuum receiver.
1—2000 gal. stainless steel jacketed reactor.
1—Blaw Knox 300 gal. stainless steel vacuum reactor.
1—Van Alst 300 gal. stainless steel jacketed kettle.
1—125 gal. stainless steel jacketed autoclave with impeller type agitator and drive, 125 psi jacket, 75 psi internal.
2—Stainless steel 2000 gal. horizontal storage tanks.
6—Blaw Knox stainless steel vacuum receivers, 200 and 100 gal.
1—Alloy Fabricators steel jacketed autoclave, 600 gal.
1—300 gal. Hastelloy "B" jacketed pressure reactor.
2—Theo. Walters Hastelloy "B" 300 gal. jacketed reactors.

CENTRIFUGES

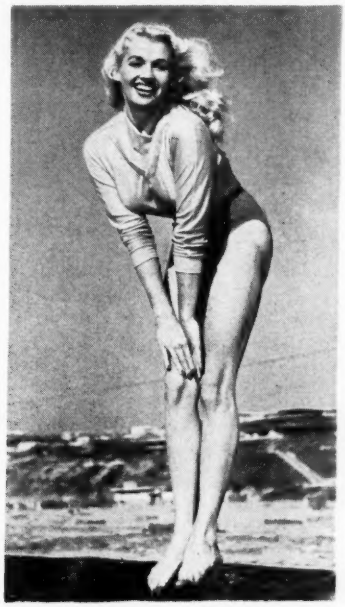
4—Sharples Type 316 stainless steel nozljectors with 40 HP explosion proof motors.
1—Bird stainless steel 40" suspended type centrifuge complete with perforate basket, plow and motor.
3—Western States Type 316 stainless steel 40" suspended type centrifuges complete with perforate baskets, plows and motors.
1—Tolhurst stainless steel 48" Batch-O-Matic centrifuge, NEW.
1—Fletcher 48" stainless and underdriven centrifuge, complete.
1—AT&M 26" Type 316 stainless steel suspended type centrifuge.
5—Tolhurst 40" and 30" rubber covered centrifuges.
1—Sharples Type 316 stainless steel Super-D-Canter, PN-14.
1—Sharples Type 316 stainless steel centrifuge, Model D-2.
1—Sharples Super-D-Hydrator, monel, Model C-27.

DRYERS

2—Louisville 8' x 50' stainless steel rotary dryers.
1—Buflovak 24" x 36 chrome plated double drum dryer.
1—Allis Chalmers stainless steel rotary dryer, 6' x 50'.
10—Allis Chalmers rotary dryers, 6' x 50' and 7' x 60'.
1—Buflovak stainless steel jacketed rotary vacuum dryer, 5' x 30'.
1—Link Belt steel roto louvre dryer, Model 207-10.
1—Link Belt steel roto louvre dryer, Model 502-20.
1—American 42" x 120" double drum dryer, ASME, complete.
1—Buflovak steel jacketed rotary dryer, 3' x 15'.
2—Stainless steel pilot plant spray dryers.

FILTERS

2—Oliver stainless steel rotary filters, 3' x 2' and 3' x 4'.
12—Sweetland #12 pressure leaf filters with 72 stainless leaves.
1—Niagara stainless steel filter, Model 510-28.
1—Sperry 36" x 36" heresite covered filter press, 40 chambers.
10—Shriver plate and frame filter presses, 12" to 42".



THE GELB GIRL—OCTOBER 1961

MIXERS

1—Abbe 10 gal. steel double arm sigma blade jacketed mixer.
1—J. H. Day 200 gal. stainless steel double arm sigma blade jacketed mixer.
3—Sprout Waldron 30 cu. ft. jacketed double ribbon blenders, steel.
1—Gemco stainless steel double cone jacketed blender, 69 cu. ft.
1—Sturtevant #7 dustite rotary batch blender, NEW.
15—Robinson Type 304 stainless steel horiz. blenders, 255 cu. ft.
1—Robinson Type 304 stainless steel horiz. blender, 125 cu. ft.
1—Baker Perkins 150 gal. dispersion type mixer, complete.
1—J. H. Day 5 gal. double arm sigma blade mixer, stainless steel.
1—Stokes stainless steel granulating mixer, Model 21-J.
1—Patterson-Kelley stainless steel twin shell blender, 2 cu. ft.

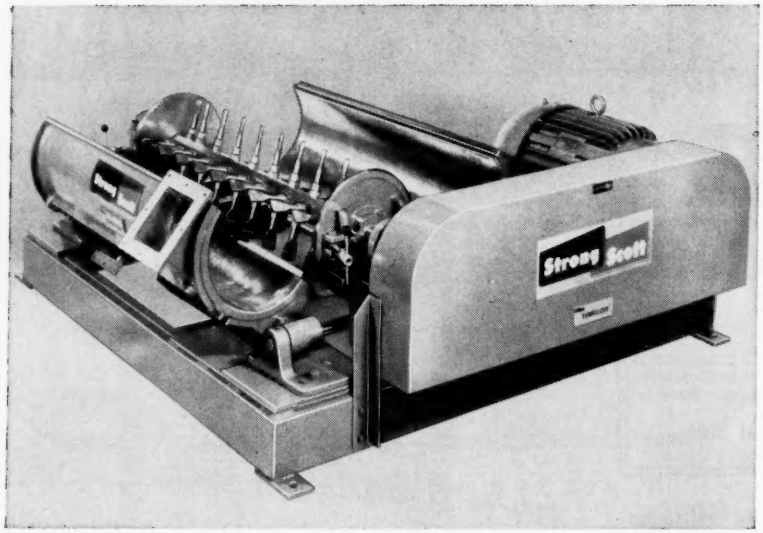
MISCELLANEOUS

1—Rietz stainless steel pilot plant grinder.
3—Mikro #3TH stainless steel pulverizers.
150—Worthite and Durimet centrifugal pumps, all sizes.
2—Mikro Bantam pulverizers.
1—Struthers Wells stainless steel 1150 sq. ft. single effect evaporator.
1—Swenson triple-effect evaporator, 5' diameter, 9' diameter, 9' diameter, complete.
2—Cleaver Brooks package steam generators, 150 HP and 500 HP, 160 psi.
1—Superior 300 HP package steam generator, 125 psi.
1—Sprout Waldron pelletizer, Type 501FF.
1—Williams "Comet" 4 roll mill, complete.
1—Raymond 2 roll high side mill.
1—Vulcan stainless steel bubble cap column, 4' dia. x 25 plates.
1—Griscom Russell stainless steel heat exchanger, 900 sq. ft.
3—Badger stainless steel heat exchangers, 500 and 600 sq. ft.
4—Patterson stainless steel condensers, 200 and 300 sq. ft.
20—Davis Engineering stainless steel heat exchangers, 102, 119, 136, 166 sq. ft., NEW.
4—Pfaudler glass lined thimble type condensers, 9, 14 and 62 sq. ft.

1—Stokes stainless steel jacketed rotary vacuum dryer, 3' x 10'.
1—Struthers Wells stainless steel rotary dryer, 5' x 25'.
2—ADT stainless steel lined rotary steam tube dryers, 42" x 30' long.
2—Young stainless steel 4 cu. ft. double ribbon blenders.

R. GELB & SONS, INC.
U. S. HIGHWAY 22, UNION, N. J. · MURDOCK 6-4900
75 ANNIVERSARY

CIRCLE X ON READER SERVICE CARD



Strong-Scott 14 inch Turbulizer . . . Clam-shell Type.

PROCESSING EFFICIENCY MULTIPLIES WITH USE OF NEW VERSATILE STRONG-SCOTT TURBULIZER®

Increased production, improved product quality and better profits.

The Turbulizer offers exceptional performance for CONTINUOUS PROCESSING in the Chemical, Food and Plastics Industries.

The Turbulizer is a continuous reactor for Solids-Solids, Liquids-Solids, and Gas-Solids, in processing areas such as MIXING, HOMOGENIZATION, PLASTIC CALENDERING, PIGMENT DISPERSION, ABSORPTION, ADSORPTION, CRYSTALLIZATION, DRYING, NEUTRALIZATION and HEATING.

Turbulizers are available constructed of carbon steel, stainless steel, nickel or other alloys. Jackets for heating or cooling are available.

MAY WE HELP YOU WITH YOUR PROCESSING PROBLEMS?

If you have a processing problem, contact Strong-Scott or our representative. We maintain a Customer Testing Service Laboratory equipped with production size equipment to evaluate the application of our equipment to your process. This service and the confidential test report are provided on a no-charge basis.

TURBULIZER BROCHURE AVAILABLE

Also see the complete Strong-Scott line on pages 909-912 of CEC.

Call or write

The Strong Scott Mfg. Co.

451 Taft Street N. E. • Minneapolis 13, Minnesota

Phone: STerling 1-7461

Index to Advertisers

Aerovent Fan Co. ... 286
Air Preheater Corp. ... 242
Air Reduction Sales Co. ... 18-19
Aldrich Pump Co. ... 159
Alemite, a division of Stewart-Warner Corp. ... 69
Allied Chemical Corp.
General Chemical Div. ... 91
Nitrogen Div. ... 62
Plastics Div. ... 149
Solvay Process Div. ... 115
Allis-Chalmers ... 48-49
Alloy Steel Products Co. ... 78
Aluminum Co. of America Chemical Div. ... 233
Aluminum Co. of America Process Industries ... 275, 277, 279, 281
Aluminum Co. of America Rome Cable Division ... 145
American Air Liquide ... 282
American Hard Rubber Co. ... 111
American Machine and Metals, Inc. ... 235, 236, 237, 238
American Standard Controls Division ... 61
Anderson Company, V. D. ... 300
Annin Company ... 229
Armour Industrial Chemical Co. ... 16-17
Armstrong Machine Works ... 263
Automatic Transportation Co. ... 129
Avien, Inc. ... 117

Bailey Meter Co. ... 150
Baker-Perkins, Inc. ... 137
Baldwin-Ehret-Hill, Inc. ... 97
Barber-Greene Co. ... 40-41
Bartlett-Snow-Pacific, Inc. ... 251
Barton Instrument Co. ... 258
Basic Incorporated ... 8-9
Bastian Blessing Co. ... 259
Belmont Packing & Rubber Co. ... 249
Bemis Bros. Bag Co. ... 163
Bethlehem Steel Co. ... 50
B-I-F Industries ... 317
Bird Machine Co. ... 2
Blaw-Knox Co. Buflovak Equipment Div. ... 154
Bridgeport Brass Co. ... 152
Bristol Co. ... 142
Burgess Manning Co. ... 280

California Chemical Co. Oronite Division ... 215
Carborundum Company ... 54-55
Carey Mfg. Co., Philip ... 10-11
Celanese Corp. of America ... 51-52
Chemical Industries Exposition ... 286
Chicago Bridge & Iron Co. ... 93
Chiksan Co. ... 144
Clark Cooper Division of Frederic B. Stevens, Inc. ... 288
Clark Equipment Co. ... 143
Cleaver Brooks Co. (Boiler Div.) ... 119
Combustion Engineering, Inc. Raymond Division ... 164
Commercial Filters Corp. ... 32
Commercial Solvents Corp. ... 209
Conax Corporation ... 240
Conoflow Corp. ... 64
Continental Mfg. Co. ... 107
Cook, C. Lee Div. of Dover Corp. ... 67
Coppus Engineering Corp. ... 151
Croll Reynolds Co. ... 295

Darnell Corp. ... 278
Davenport Machine & Foundry Co. ... 296
Day Co., The ... 268
DeBothezat Division ... 238
DeLaval Separator Co. ... 42-43
Deming Div. of Crane Co. ... 203
Dempster Bros. ... 60
Dodge Mfg. Co. ... 264, 265
Dorr Oliver Incorporated ... 88-89

Dow Chemical Co.
Saran Lined Pipe Co..... 124
Dow Corning Corp..... 213
Dracco Division of the
Fuller Co. 245
du Pont de Nemours & Co. (Inc.),
E. I.
Finishes Dept. 74
du Pont de Nemours & Co. (Inc.),
E. I.
Polychemicals Dept. (Teflon)... 121
Durolay Co. 311
Duriron Company, Inc..... 211

Eco Engineering Co..... 72
Eimco Corporation .....Second Cover
Electric Controller & Mfg. Division
Square D Company 73
Elliott Company 38-39
Ever-tite Coupling Co., Inc..... 99

Fairbanks, Morse & Co.
(Scale Division) 207
Falls Industries, Inc. 141
Falk Corporation 12-13
Federated Metals Division of
American Smelting & Refining
Co. 128
Fibercast Company, Division of
Youngstown Sheet and Tube Co.. 261
Filtration Engineers 235
Fisher & Porter Co..... 205
Flowline Corp. 105
Fluid Energy Processing &
Equipment Co. 256
Foxboro Co. 44-45
Freeport Sulphur Co..... 201
Fuller Company 315

Galigher Company, The..... 6
Garlock, Inc. 134
Gast Manufacturing Co..... 300
General American Transportation
Co. (Kanigen) 156
General Electric Co.....24-25
Glas-Col Apparatus Co.....22-23
Goodrich Industrial Products Co.,
B. F. 1
Goslin-Birmingham Mfg. Co..... 316
Great Lakes Carbon Co.
Electrode Division 71
Grinnell Co. 148
Groen Mfg. Co..... 313

Hagan Chemicals & Controls, Inc.. 139
Hammel-Dahl Division of
General Control Co.....36-37
Hankison Corporation 254
Harbison Walker Refractories Co.
125-126
Hardinge Company 266
Harrisburg Steel Co..... 66
Harshaw Chemical Co..... 135
Hayes, Inc., C. I..... 291
Haynes Stellite Co., Div. of
Union Carbide Corp..... 223
Hercules Packing Corp..... 232
Hills McCanna Co..... 70
Hooker Chemical Corp..... 221
Hough Co., Frank G..... 157
Howes Co., Inc., S..... 298
Humble Oil & Refining Co..... 219
Huntington Alloy Products Div.
International Nickel Co., Inc.... 267
Hyromatics, Inc. 33-34

Ingersoll Rand Co.....20-21
Instruments, Inc. 314
International Business Machines..30-31

HOW TO BEAT THE HEAT

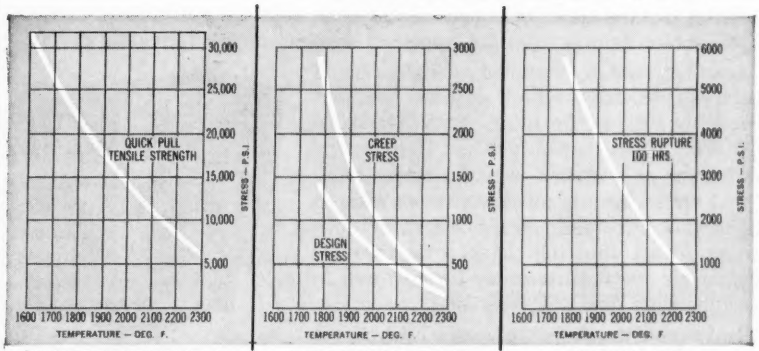
for strong high alloy requirements in the 1,800° to 2,300° F range!

DURALOY HOM*

*Covered by U.S. Patents

casting alloy

Duraloy "HOM" is a special high nickel alloy developed to produce castings that meet high temperature requirements, especially when castings are subject to oxidizing atmospheres.



CURVES SHOWING HIGH TEMPERATURE SHORT-TIME TENSILE STRENGTH OF DURALOY-HOM

CURVES SHOWING CREEP STRESS FOR CREEP RATE OF 1% IN 10,000 HOURS AND RECOMMENDED DESIGN STRESS FOR DURALOY-HOM

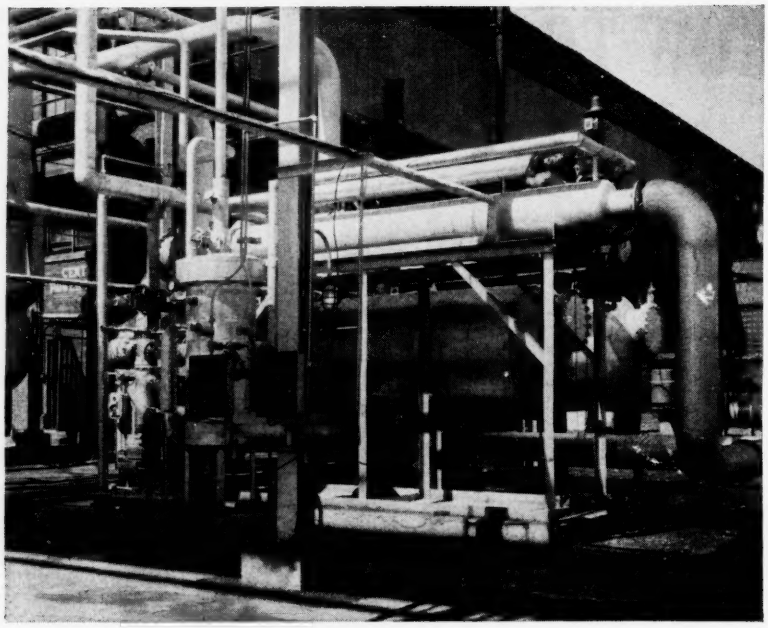
CURVE SHOWING STRESS TO RUPTURE AT 100 HOURS FOR DURALOY-HOM

Castings of DURALOY "HOM" are now being produced by our three methods: static, centrifugal and shell molded. Write today for additional information on this versatile new alloy.

ALLOY CASTING INSTITUTE ACI MEMBER

The DURALOY Company

OFFICE AND PLANT: Scottdale, Pa.
EASTERN OFFICE: 12 East 41st Street, New York 17, N. Y.
CHICAGO OFFICE: 332 South Michigan Avenue, Chicago, Ill.
DETROIT OFFICE: 1025 Maple Road, Troy, Michigan.
HOUSTON OFFICE: 4101 San Jacinto, Houston 4, Texas.



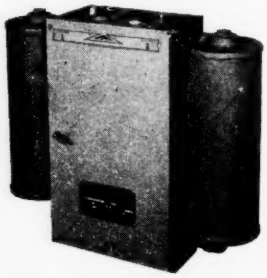
AT ESSO'S BAYWAY REFINERY...

Central Lectrodryer serves entire plant, keeps instrument and tool air desert-dry

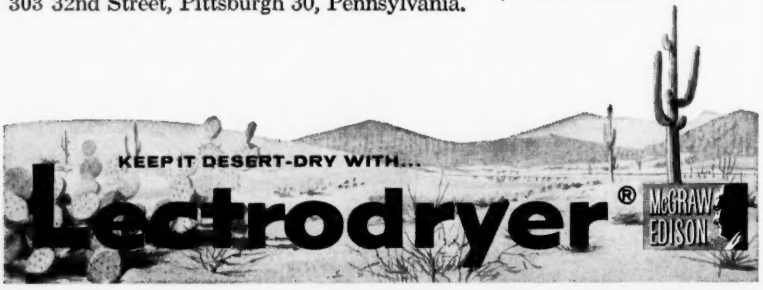
A steady flow of moisture-free instrument air is essential to smooth-running refinery operations. Lectrodryers have long been used at the Bayway Refinery of the Esso Standard Division of Humble Oil and Refinery Company, Linden, New Jersey, to control moisture content in individual instrument systems. But the addition of new instruments, more controls and air-driven tools eventually overtaxed the combined capacity of the individual dryers.

Esso has recently installed a single, central Lectrodryer, from which dry air is piped throughout the entire plant. In addition to year-round protection against instrument freeze ups, this system provides ample additional air to operate air-driven tools without the need of anti-freeze; means better tool lubrication, longer tool life. Moreover, there is neither air nor maintenance time wasted in bleeding lines dry.

Investigate the benefits of such a Lectrodryer system by writing for case history sheets illustrating in detail specifications and solutions to a multitude of moisture problems. Pittsburgh Lectrodryer Division, McGraw-Edison Co., 303 32nd Street, Pittsburgh 30, Pennsylvania.



Lectrodryer's wide range of drying apparatus also includes this budget model, which delivers small quantities of extremely dry air for wave guides, small cubicles, instrument systems and the like.



ADVERTISERS . . .

James Mfg. Co., D. O. 228
Jerguson Gage & Valve Co. 296
Johns-Manville Corp. (Celite) 165
Jones Corp., E. D. 291
Joy Manufacturing Co. 225

Kahn & Co. 274
Kellogg Co., M. W. 147
Kemp Mfg. Co., C. M. 80
Kennametal, Inc. 292

LaBour Company 53
Layne & Bowler, Inc. 65
Linde Co., Div. of Union Carbide Corp. 230, 231
Liquidometer Corp. 253
Lummus Co. 35

Magnetrol, Inc. 313
Manning, Maxwell & Moore, Inc. 82
Manton Gaulin Mfg. Co. 217
Manzel Division of Houdaille Industries 297
Marlo Coil Co. 257
Mechanical Products Corp. 314
Metal Hydrides, Inc. 103
Midland Industrial Finishes, Inc. .. 294
Midwest Piping, Div. of Crane Co. .. 59
Milton Roy Co. 4
Mineral Insulated Division of General Cable Corp. 262
Mine & Smelter Co. 290
Minneapolis-Honeywell 14-15, 288
Minnesota Mining & Mfg. Co. 283
Morehouse-Cowles, Inc. 274
Multi-Metal Wire Cloth Co. 300
Murray Mfg. Co., D. J. 317

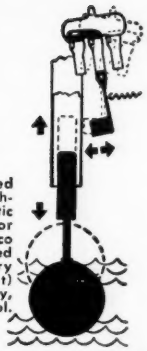
Nash Engineering Co. 146
National Filter Media Corp. 278
National Carbon Co., Div. of Union Carbide Corp. 76
Newport News Shipbuilding & Dry Dock Co. 130
Niagara Filters Div. 236
Nicholson & Co., W. H. 293
Norton Company (Refractories) ... 81

Ohio Injector Co. 136

Pangborn Corp. 109
Peerless Pump, Hydromatics Div. Food Machinery & Chemical Corp. 127
Penberthy Mfg. Co., Div. of Buffalo Eclipse Corp. 247
Permutit Co., Div. of Pfaudler Permutit, Inc. .. Fourth Cover
Pfizer & Co., Charles .. 255, 283, 299, 313
Philadelphia Gear Corp. (Mixer Div.) 122
Pittsburgh Chemical Co. 46-47
Pittsburgh Des Moines Steel Co. 77
Pittsburgh Lectrodryer Div. of McGraw-Edison 312
Platecoil Division of Tranter Mfg. Co. 140
Powell Valves, Wm. Powell Co. 113
Power Curve Conveyor Corp. 317
Premier Mill Corp. 296
Protectoseal Co. 241

Raybestos-Manhattan, Inc. Plastics Div. 250
Reynolds Metals Co. 239
Robbins & Myers, Inc. 79

permanent magnetic force...



A sleeve, raised and lowered within a nonmagnetic tube, attracts or releases an Alnico magnet attached to the mercury (or dry contact) switch. Basically, this is Magnetrol.

The operating principle behind MAGNETROL® LIQUID LEVEL CONTROL

Because its operating principle, based on the proper use of a permanent magnet, guarantees a perpetual guardianship over your critical liquid levels, the Magnetrol liquid level control unobtrusively takes the most important place in any system or process where it is necessary to keep a liquid at a constant level. Principle and action are so simple that failure is virtually impossible. Magnetrol is versatile, too—will handle almost ANY liquid, at ANY temperature, at ANY pressure, with the same precision and dependability. No mechanical or electrical linkages to stick, bind, ride out of line or wear out. Available for controlling level changes from ⅛" to 150 ft. Multi-stage switching when desired. Write to

MAGNETROL, Inc., 5324 BELMONT ROAD, DOWNERS GROVE, ILL.

A Versatile Industrial Organic Acid...

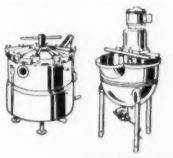
CH_2COOH
$HOC-COOH$
CH_2COOH

GROEN

STEAM JACKETED KETTLES

meet every processing and mixing need!

The contrast between kinds of products, where a cook-mix process is employed, staggers the imagination. We frankly don't know how many industries require this type of processing. But if you have a need for minutely controlled temperatures for either heating or cooling combined with thorough mixing or agitating, Groen steam jacketed kettles provide the most efficient method ever developed. Groen engineering research brings you unexcelled heat transfer faster, easier, with substantial savings in time and labor. Groen stainless steel processing vessels are easier-to-clean, too, providing the ultimate in sanitation. There's a size and type for every process or product. Write for complete engineering data and specification sheets.

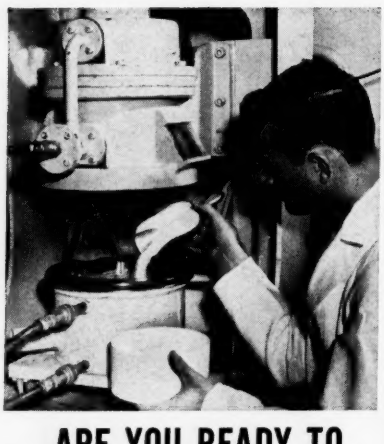


Complete line includes tanks, coils, vacuum kettles, revolving pans, tubular heat exchangers, pilot plant units and special specification equipment.

GROEN MFG. CO.

1900 Pratt Blvd., Elk Grove Village, Ill.

1377 Palisade Ave., Teaneck, N. J.



ARE YOU READY TO ADVANCE WITH UTC?

Are you a chemist or chemical engineer with a special interest in polymer chemistry research? Have you been gaining experience in this field as a member of a research group? Are you ready to assume greater responsibility as leader of a research group or section?

Would you enjoy working directly with recognized professional leaders at United Technology Corporation's modern research and development complex in the San Francisco Bay Area?

These outstanding openings are now available at UTC. You are invited to write for complete details.

SECTION CHIEF—PROCESS RESEARCH—This position available as a result of continued expansion in propellant research. Typical candidate will possess an extensive background solving problems connected with propellant processing research, scale-up and elastomers. An advanced degree in chemistry or chemical engineering with 7-years experience is necessary. Must have thorough knowledge of solid propellants. Will supervise and give technical direction to the Process Operations Research Section and report to the head of our Research Propellant Processing Department.

DEVELOPMENT CHEMIST—This unusually attractive position in our Propellant Processing Research Department will be filled by a candidate holding a masters degree in organic chemistry. Will assume responsibility for the direction of a group engaged in liner problems. Qualified applicants will have several years experience with adhesives, and polyurathane and polybutadiene base polymers. Must be creative and capable of assuming complete responsibility.

All qualified applicants considered without regard to race, creed, color or national origin.

UTC

Contact: C. F. Gieseler, Dept. 107

UNITED TECHNOLOGY CORPORATION

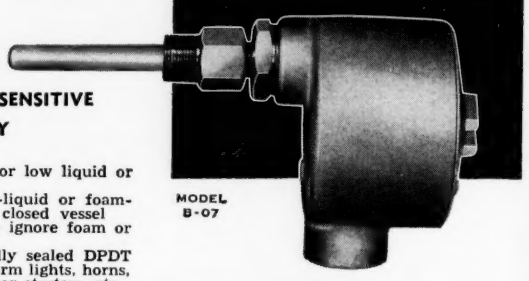
A subsidiary of United Aircraft Corporation

P. O. Box 358 Sunnyvale, California

Do you need level control?

. . . then you need

ELECTR-O-PROBE®



MODEL B-07

A CAPACITANCE-ACTUATED SUPER-SENSITIVE ELECTRONIC RELAY

1. Will indicate high or low liquid or solid level
2. Will control liquid-liquid or foam-liquid interface in closed vessel
3. May be adjusted to ignore foam or detect foam
4. Contains hermetically sealed DPDT relay to energize alarm lights, horns, solenoid valves, motor starters, etc.
5. Teflon covered probe
6. 12-24 VDC or 115 VAC

Other **ELECTR-O-PROBE** models include —

B-04 — super-sensitive relay for foam, interface, etc.

B-05 — general purpose relay for liquid or solid level detection

B-06 — self-contained, general purpose, tank-side mounting

ELECTR-O-PROBES are used NOW for detection of heavy fluids, acids and fluid interface in chemical plants; alarm for refrigerant control in freezing plants; mixed feed control; water-oil interface in refineries; detection of liquors and foam in pulp and paper mills.

WRITE FOR BULLETINS

INSTRUMENTS INCORPORATED TULSA

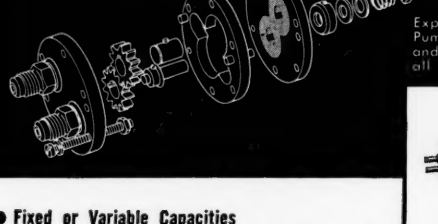
INSTRUMENTS, INC.

BOX 556 TULSA, OKLA.

PIONEERS IN LEVEL MEASUREMENT AND CONTROL INSTRUMENTATION

MAISCH METERING PUMPS

FOR BIOLOGICAL, INDUSTRIAL OR SANITARY USE



Exploded drawing of Maisch Industrial Pump showing complete accessibility and simplicity of assembly typical of all Maisch engineered pumps.

- **Fixed or Variable Capacities**
- **Positive Displacement, Uniform, Non-pulsating flow**
- **Extremely Compact Design**
- **Rigid or Demountable Types**

Maisch Metering Pumps are simple in design and ruggedly built for long service. They are widely used for handling chemicals, syrups, oils, glue, processing solutions, etc. They can dispense boiling hot, ice cold, watery, or highly viscous liquids with equal efficiency. Available in wide range of capacities from 0 to 217 GPH. Materials: Biological and Industrial Pumps—Stainless Steel; Sanitary Pumps—Stainless Steel, or Plastic.

Immediately available.

Complete details and prices available upon request.

VARIABLE CAPACITY PUMPS—0-144 GPH

FIXED CAPACITY PUMPS—10-217 GPH

FIXED CAPACITY SANITARY PUMPS—17-152 GPH

mechanical mp products

MECHANICAL PRODUCTS CORPORATION

1716AW Hubbard St. • Chicago 22, Illinois

ADVERTISERS . . .

Robertshaw Fulton Controls Co.
Fulton Sylphon Div. 243
Rockwell Manufacturing Co., W. S. 292
Rotron Controls 274

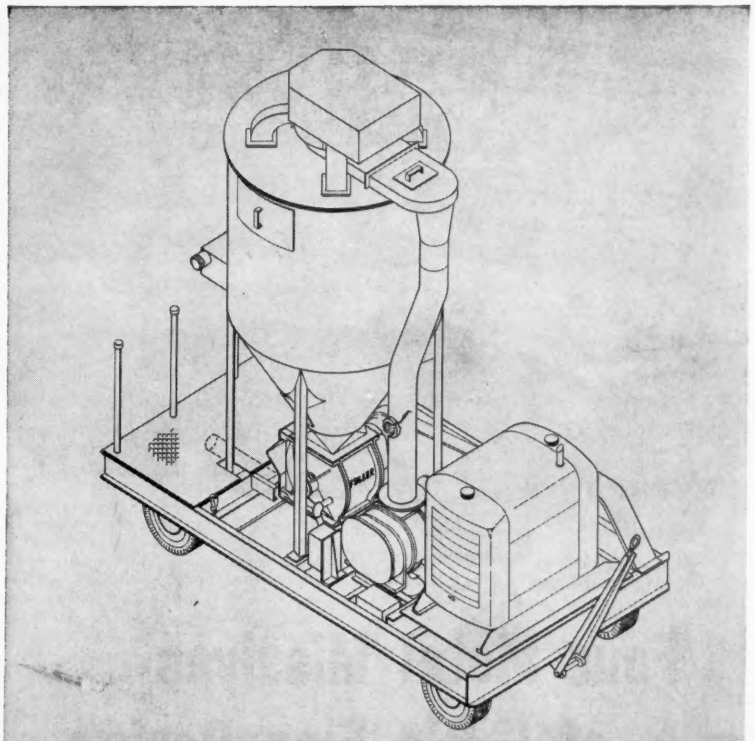
Sarco Company 132
Schutte & Koering Co. 133
Selas Flotronics, Div. of
Selas Corp. of America 255
Sharples Corporation 56-57
Shell Oil Co. 86
Shriver & Co., T. 283
Southwestern Engineering Co. 158
Sperry & Co., D. R. 123
Square D Company
E C & M Division 73
Standard Tube Co. 318
Stockham Valves & Fittings 131
Stokes Corp., F. J. 284
Strahman Valves, Inc. 255
Strong Scott Mfg. Co. 310
Sturtevant Mill Co. 290
Swenson Evaporator, Div. of
Whiting Corporation 251

Thermal American Fused Quartz
Co. 299
Thermo Electric Co. 248
Thiokol Chemical Corp. 58
Timken Roller Bearing Co. 155
Titanium Metals Corp. of
America 68
Toledo Scale Div. of
Toledo Scale Corp. 294
Tolhurst Division 237
Torit Manufacturing Co. 260

Union Iron Works 83
U. S. Electrical Motors ..... Third Cover
U. S. Rubber Co.
(Mechanical Goods) 26-27

Advertising Sales Representatives

Atlanta 9 ..... R. K. Burnet
1375 Peachtree St., N. E., TRinity 5-0523
Boston 16 ..... A. S. Reed
McGraw-Hill Bldg., Copley Square, COngress 2-1160
Chicago 11 ..... Gene Davis, J. M. Rodger, Jr.
645 N. Michigan Ave. MOhawk 4-5800
Cleveland 13 ..... John C. Mitchell
55 Public Square SUperior 1-7000
Dallas 1 ..... F. E. LeBeau
Vaughn Bldg., 1712 Commerce RIverside 7-9721
Denver 2 ..... John Patten
1700 Broadway ALpine 5-2981
Detroit 26 ..... Chas. M. Crowe, Jr.
856 Penobscot Bldg. WOodward 2-1793
Frankfurt/Main ..... Stan Kimes
85 Westendstrasse
Geneva ..... Michael R. Zeynel
2 Place du Port
Houston 25 ..... J. C. Page
W-724 Prudential Bldg. JAckson 6-1281
London EC4 . E. S. Schirmer, Edwin E. Murphy
95 Farringdon St.
Los Angeles 17 ..... John B. Uphoff
1125 W. Sixth St. HUntley 2-5450
New York 36 . . R. G. Frederick, A. L. Gregory, John R. Emery
500 Fifth Ave. OXford 5-5959
Philadelphia 3 . . . . M. A. Loy, Jr., L. D. Zerone
6 Penn Center Plaza LOcust 8-4330
Pittsburgh 22 ..... G. S. Ryan
4 Gateway Center EXpress 1-1314
Portland 4 ..... Scott B. Hubbard
Room 445, Pacific Bldg. CApitol 3-5118
St. Louis 8 ..... J. M. Rodger, Jr.
3617 Olive Street JEfferson 5-4867
San Francisco 11 ..... R. T. Koch
255 California St. DOuglas 2-4600



Safe, clean, jam-safe transfer of dusty chemicals, grains and flours is now possible with the advanced filter design of this new pneumatic transfer unit.

Newest FULLER portable transfer unit handles dusty materials

Designed to handle a wide range of dusty materials such as plastics, chemicals, grains and flours, the newest Fuller Transfer Unit is a continuous filter type for dense stream pneumatic conveying.

Principal design feature of the new high capacity transfer unit is a newly developed, completely automatic filter. This unit is of extremely simple construction, its filter elements being cleaned continuously by a single master valve driven by a 1/8 hp. motor. The valve has only one moving part, the rotor, which is carried in two bearings, sealed for life.

Fuller Portable Airveyor Transfer Units are of the combination vacuum-pressure type, with the vacuum side picking up the material and the pressure side delivering it to the desired destination. Unit is available with power supply by either electric motor (as shown here) or gasoline engine.

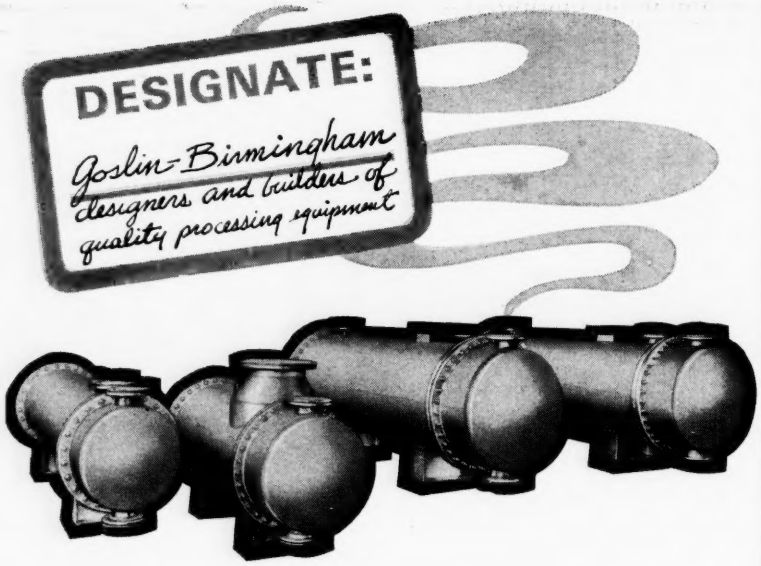
Low cost, rapid handling to and from cars, trucks, storage bins and silos is available for many granular and pulverized materials. Hook-ups are fast and the unit is quickly moved from one job to another. Materials movement is rated up to 20 tons hourly in 3" or 4" lines.

See Chemical Engineering Catalog for further details and specifications.

3140
A-290

FULLER COMPANY
134 Bridge St., Catasauqua, Pa.
Subsidiary of General American Transportation Corporation
Offices in Principal Cities Throughout the World

Fuller
pioneers in harnessing AIR



Four Metal Missives of G-B's Fine Design

No, these four shiny tubes are not miniature rockets, subs, or secret weapons. But they were given the letter of fine design and skilled manufacture that must go into any GOSLIN-BIRMINGHAM product.

Actually, these are exchangers for acetic acid distillation. Theirs is the job of condensing acetic vapors and cooling the resultant liquid.

The units from left to right are: (1) a 26" dia., acid recovery cooler; (2) a 32½" dia., acetic flashing column condenser; (3) and (4) 40½" dia., acid recovery sub-coolers.

All four units are of stainless steel throughout, with 1" OD tubes and fixed tubesheets welded inside of shells.

Write or call for information. See our catalog in Chemical Engineering Catalog.

GOSLIN-BIRMINGHAM
MANUFACTURING CO., INC.
P. O. BOX 631 BIRMINGHAM, ALABAMA
FILTERS • EVAPORATORS • PROCESS EQUIPMENT • CONTRACT MANUFACTURING including HEAVY CASTINGS

ADVERTISERS . . .

U. S. Stoneware Co. 84
United Technology Corp. 314

Vapor Recovery Systems Co. 153
Vilter Manufacturing Co. 246
Vogt Machine Co., Henry 166
Voss Co., Inc., J. H. H. 299

Wallace & Tiernan, Inc. 272, 273
Walworth Company 28-29
Waukesha Foundry Co. 234
Welded Steel Tube Institute, Inc. 138
Wellington Sears Co. 244
Western Supply Co. 101
Wiegand Co., Edwin L. 260
Williams Patent Crusher & Pulverizer Co. 227
Wyandotte Chemical Corp. Michigan Alkali Division . 285, 287, 289

Yarnall-Waring Co. 75
Yuba Consolidated Industries 63

PROFESSIONAL SERVICES 301

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES . . 301, 302

NOTICES
Legal 301

EQUIPMENT
(Used or Surplus New)
For Sale 303-309

ADVERTISERS INDEX

American Air Compressor Corp. 303
Bechtel Corporation 302
Best Equipment Co. 303
Brill Equipment Company 305
Bristol Company 302
Carus Chemical Co., Inc. 302
Dalton Supply Co. 303
Dow Industrial Service Division, Dow Chemical Company 302
Equipment Clearing House Inc. 303
Equipment Finders Bureau 303
First Machinery Corp. 306
Gelb & Sons Inc., R. 309
Heat & Power Co., Inc. 304
Indeck Power Equipment Co. 303
Lago Oil & Transport Co., Ltd. 302
Lawler Co. 303
Linde Co., Union Carbide Corp. 301
Loeb Equipment Supply Co. 308
Machinecraft Corp. 308
Machinery & Equipment Co., Inc. 303, 308
Machinery & Equipment Co. 303
McGraw-Hill Publishing Co. 302
McKee & Co., Arthur G. 302
Perry Equipment Co. 307
SMC Industries, Inc. 308
Stanhope Inc., R. C. 303
Stein Equipment Co. 303
Union Standard Equipment Co. 308
Victor Chemical Works Div., Stauffer Chemical Co. 302

A storehouse of accepted methods, data, principles . . .

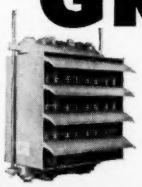
COST ENGINEERING IN THE PROCESS INDUSTRIES

Over 500 pages of practical "how to" information reprinted from Chemical Engineering. Published by McGraw-Hill Book Co. Price $11. Order direct or through

Reprint Department
Chemical Engineering
330 West 42nd St.,
New York 36, N.Y.

Only With

GRID



UNIT HEATERS AND BLAST HEATERS

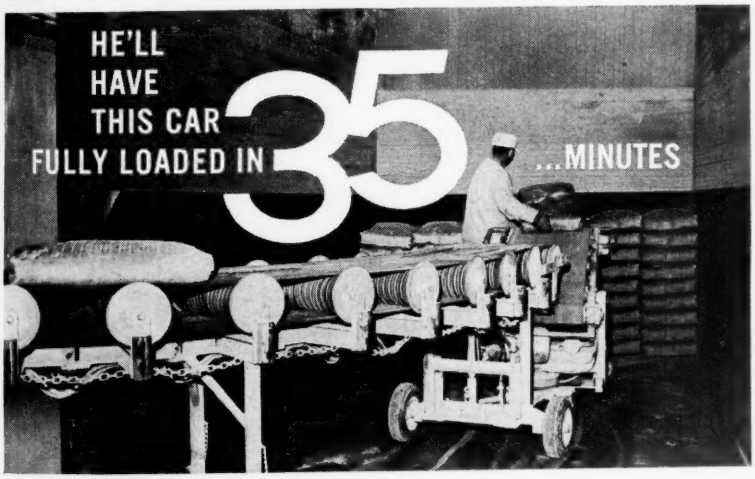
CAN YOU GET MAINTENANCE-FREE TROUBLE FREE *Life Long* HEATING SERVICE

Installations in 1929 are still operating without repairs. GRID construction and material — inside and out — account for GRID Life Long Heating Service. GRID one piece cast iron steam chambers and headers eliminate internal corrosion . . . There's only one metal in contact with steam. Leak-proof on steam pressures up to 250 P.S.I. 450° temperature. GRID cast iron construction resists corrosion externally from acid fumes or other destructive elements in the atmosphere. Widely spaced fins cast integral with the steam chamber will not corrode and are easy to clean . . . will not "mat" on air intake side.

For trouble-free heating in your plant, write for GRID catalog No. 956.

D. J. MURRAY MANUFACTURING CO.

Manufacturers Since 1883 Wausau, Wis.



...without help, using a POWER-CURVE Loader

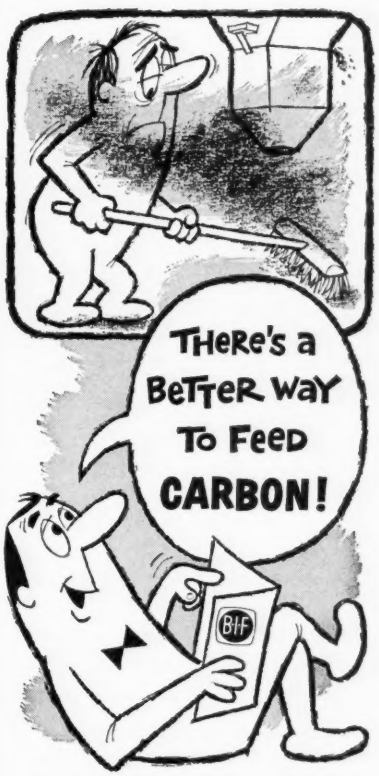
Bag loading costs of eight cents a ton are not uncommon in plants using Power-Curve equipment. One man loads and stacks direct from the packer with no need to lift a single bag. Loads can be palletized or stacked in any pattern, also put into warehouse storage.

There are Power-Curve installations near you. Let us show you how your plant can benefit from a custom engineered Power-Curve loading operation.

Literature and engineering details sent on request.

POWER-CURVE
CONVEYOR COMPANY
2185 SOUTH JASON ST., DENVER 23, COLORADO

B·I·F FIRST . . . IN MEASUREMENT AND CONTROL OF MATERIALS FLOW

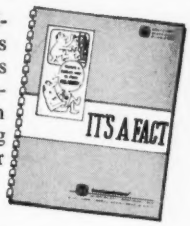


Is messy carbon feeding giving you a headache? Costly housekeeping and employee health problems cutting your profits?

Whether you're feeding floodable carbon (smoke) or free flowing granular carbon, organic or mineral carbon, B-I-F's totally enclosed feeding systems provide automatic, continuous control of the flow of this hard-to-handle material . . . at high accuracy. Regardless of material characteristics or process conditions, B-I-F has the performance-proved, engineered system for more efficient carbon feeding.

Free Facts

Continuous feeding/blending saves material, reduces costs, controls quality . . . results in bigger processing profits. Write for the Facts today!

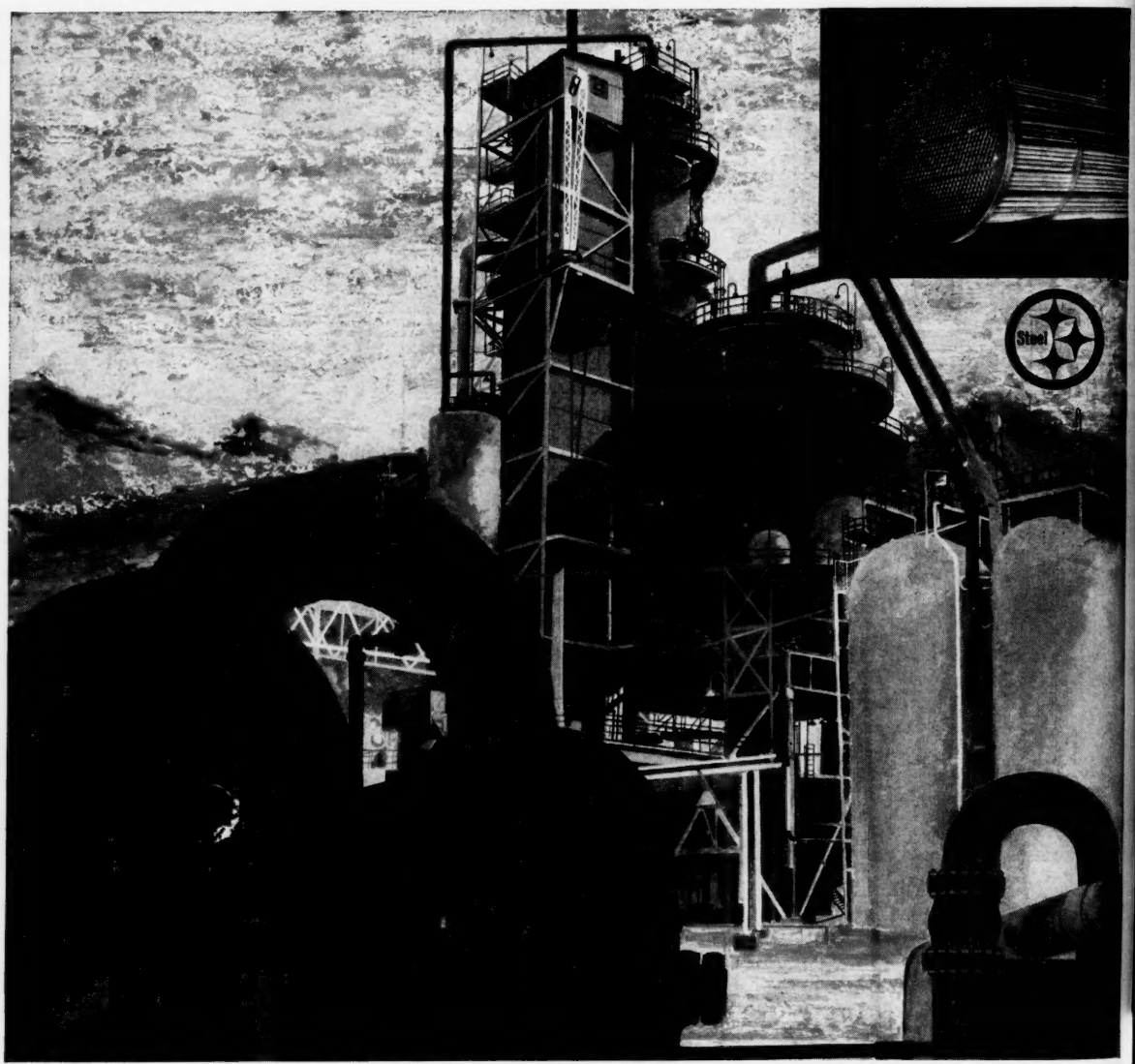


B·I·F *Industries*
A DIVISION OF THE NEW YORK AIR BRAKE COMPANY
369 HARRIS AVENUE, PROVIDENCE 1, RHODE ISLAND

Find the Invisible Workers!

It's welded steel heat exchanger tubing by The Standard Tube Company

Tubing that is easy to roll-in, bend, expand or flare . . . that's our specialty. We have the production facilities . . . the tube industry's most modern plant! We have the testing facilities . . . hydrostatic and eddy current to surpass specifications. We have the personnel . . . most of our "tubemen" have been with us for years. And Standard tubing is available throughout the country. It all adds up to lower cost, higher quality and better service when you buy Standard welded tubing. For further information on our steel and stainless steel products and capabilities, write for brochure No. 6.

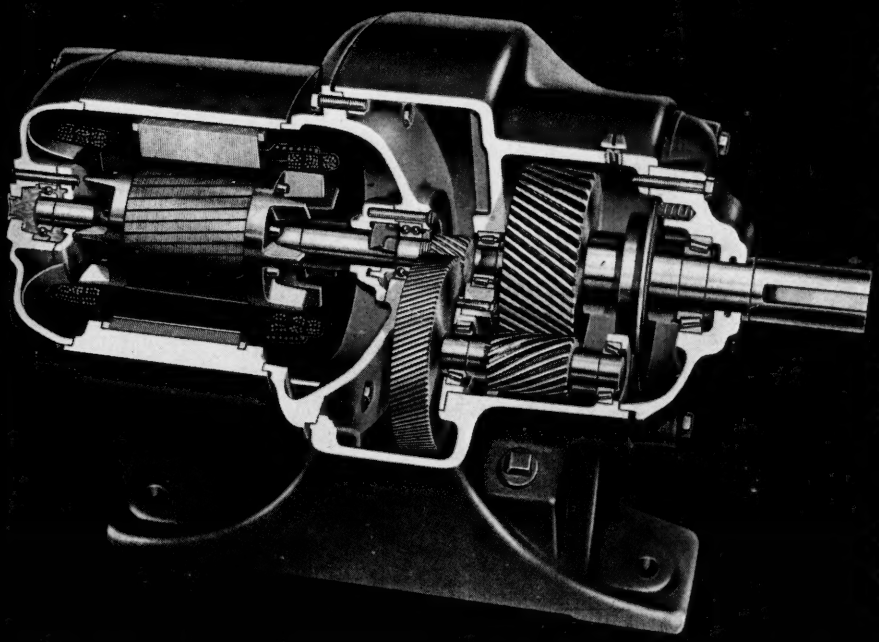


THE STANDARD TUBE CO.

Over 40 years specializing in Quality Welded Tubing

DETROIT 39, MICHIGAN

designed for LONG LIFE ...life-long dependability



Only U.S. SYNCROGEAR has all these features...

RUGGED PYRAMIDAL CASE prevents distortion or misalignment.

SOLID SHANK BUILT-IN PINION can't vibrate or work loose.

ASBESTOS PROTECTED WINDINGS will not deteriorate from heat.

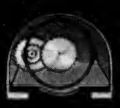
ONE-PIECE SUPPORTING CASE assures permanent alignment of gears, pinions.

THROUGH-HARDENED GEAR TEETH give greatest strength, longest wear.

NORMALIZED CASTINGS prevent warping, misalignment of gears, shafts.

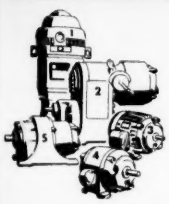
FRICTION-FREE OIL SEAL can't wear, prevents leakage.

POSITIVE AUTO-LUBRICATION by slow-gear dip prevents churning



MICRO-SHAVED AND HONED GEAR TEETH provide smooth operation, long life.

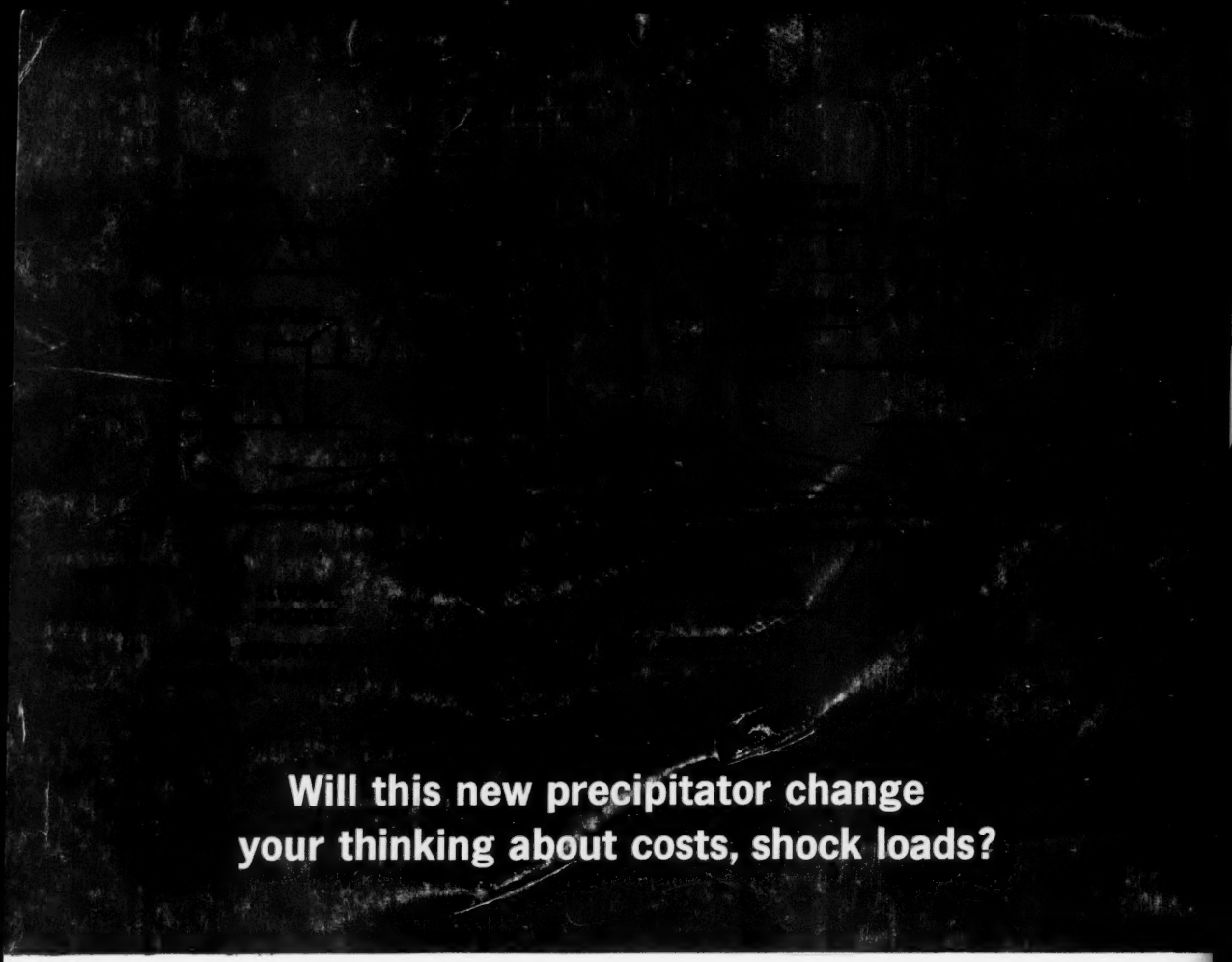
U.S. SYNCROGEAR MOTORS offer the *most features* to provide long life and dependability. For a quarter-century, U.S. Syncrogears have led design progress. (Available 1/3 to 75 h.p.—single-, double-, triple-reductions, and worm-geared.)



U.S. MAJOR MOTOR LINES INCLUDE:
1. Vertical Solid & Holloshaft, 2. Varidrive, 3. Totally-Enclosed, 4. Uniclosed, 5. Syncrogear. Also, many other special motors.

FREE SYNCROGEAR BROCHURE No. F-1880
Color illustrated

U.S. ELECTRICAL MOTORS INC.
P.O. Box 2058 • Los Angeles 54, California or Milford, Conn.



Will this new precipitator change your thinking about costs, shock loads?

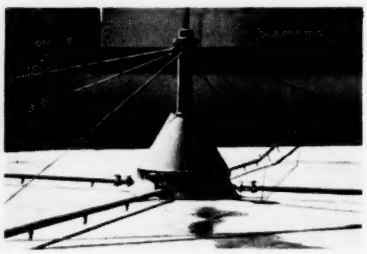
New Permutit Type M Precipitator . . . a study in simplicity

Now in operation is this new precipitator for reducing turbidity and color in water.

We call it the Permutit Type M Precipitator. It is a study in simplicity, and because of its low construction and operating costs, it opens up new opportunities to obtain solids-contact clarification at minimum cost.

"Missing" parts: There is no motor-driven agitator on the Permutit Type M Precipitator. No extensive baffling. No center platform. No access walkway. All these have been done away with, because the unit has a new and different agitator system which sweeps away the settled sludge. Rotating agitator arms are supported by a "semi-buoyant" hub (or float) which revolves about a bearing post on the tank floor. Recycled effluent drives the agitator through jet nozzles located at the end of each arm. Smaller jets, spaced along the arms, gently nudge the settled sludge toward a sump at the outer rim of the tank floor.

Briefly, this is how the M unit works: raw water and chemicals are mixed in line and enter at the center of the tank floor beneath the conical rotor float which deflects the fluid mixture radially outward to the walls. A horizontal baffle on the tank wall then reverses the flow back toward the center thus imparting a rolling action to the sludge blanket. This current flow constantly places previously formed sludge in intimate mixture with the raw water immediately as it enters the tank. Clarified, effluent is collected by a flume at the top.



Agitator float and hub assembly.

Sudden water changes: An additional benefit of the Permutit Type M Precipitator is its exceptional ability to handle shock loads.

A case in point: red dye from a paper mill a mile upstream showed up one day in the raw water entering a Permutit Type M Precipitator in use in New England. But the unit went right on putting out an effluent with no significant change in quality.

So much interest has been shown in this new unit that we have reprinted the paper, "A Recent Development in Solids Contact Clarification Design", by E. D. Driscoll of Permutit. We'll be glad to send you a copy.

Write to Permutit Division, Dept. CE-101, 50 West 44th St., New York 36, New York. (In Canada, contact the Permutit Company of Canada, Toronto.)

PFAUDLER PERMUTIT, INC.

Specialists in FLUIDICS . . . the science of fluid processes